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GENERAL SIR J. F. BURGOYNE, BART. G.C.B., in the Chair.

THE RIFLE AND THE RAMPART; OR, THE FUTURE OF DEFENCE.

BY CAPTAIN H. W. TYLER, R.E.

THERE are still a number of nice, dear, old ladies in this country—long may they live in it!—who consider steam engines and railways as nasty, dangerous things, who believe that people have no right to be whirled through the air at the awful speeds of the present day, and who are firmly resolved not to place their valuable lives, at all events, at the disposal of any board of railway directors. It would answer no good end, of course, to talk to these otherwise sensible persons, of the enormous results which these "new-fangled machinations" have already produced, any more than of those which they are destined to bring about, in the different relations of mankind.

In like manner, there are many distinguished members of the sterner sex, younger in years, and military by profession, who look through a veil of prejudice at the improvements which are taking place in the weapons of war. They cannot but consider rifled muskets and guns, and elongated projectiles, to be nasty dangerous things; but they are convinced, nevertheless, that they will not produce, after all, much alteration in the actual practice of war. They regret to see such weapons being introduced into the service. They fear that the relations which have previously existed, and which ought in their opinion still to be maintained, between the three

arms, are in danger of being disturbed. They foresee that soldiers will be shooting at each other from long distances, and throwing away their ammunition, without achieving decisive results. It would be an equally thankless task to discuss with them the possible effects of these improvements, and still more so to dwell with them upon those interesting reflections, as to the power which the possession of such means of destruction confers upon civilisation, and upon the helpless condition in which barbarism will, in the end, be relatively placed.

I cannot, of course, suppose that any person holding views of this description would take the trouble to come here to-day; but I am happy now to have an opportunity of endeavouring to fulfil towards those who have done me the honour to attend, the promise which I made in this place on the 1st of April in last year.

There have been two great changes since that time in the military prospects of this country, for which we have to thank,—no apprehensions excited by vain threats or empty menaces,—but the actual demonstrations and preparations of the Emperor, our neighbour.

I took that opportunity of strongly advocating, as others had done before me, the establishment of volunteer corps; but I little thought how soon that movement was to commence, which has since taken root, has sprung up, has shot its branches over the length and breadth of the land, and has already so abundantly brought forth fruit.

But, as a general law of nature, rapid growth is followed by quick decay. A man forgets most readily that which he learns most easily; and values least what he acquires with the smallest difficulty. In vegetable, as well as in animal nature, short endurance follows upon rapid growth, as an almost invariable rule. In the establishment of empires, or in the alterations of their constitutions, the same law holds good. And what we have principally to fear with regard to our rifle movement, is, that it has come to us in a storm too violent to last, and that it will dwindle away after the occasion has passed away by which it was immediately called forth. There is not much fear of this, however, as long as the political horizon maintains its present threatening aspect. A great point will have been gained, when once military organisation, military discipline, and proficiency in the use of the rifle, have acquired a firm footing in the civil ranks of life, and particularly when they are recognised as a useful element in the education of the youth of the country.

The second measure that has been happily effected, is the appointment by the Government of a Royal Commission to consider and report upon the important question of National Defence. We are now anxiously expecting to have an opportunity of seeing the Report of that Commission, and of ascertaining how they propose to expend those ten millions of money which have been so much talked about.

This is a large sum; but our Houses of Parliament have cost a quarter of it; the fortifications of Paris alone have been estimated to cost, altogether, 8,000,000 pounds sterling; and if we can place ourselves, as far as our fortifications are concerned, in a condition of security for something approaching to that amount, we shall do well. The prosperity of this country depends upon its commerce. The parent of commerce is confidence. By a judicious system of permanent works, and by a wise expenditure of

money amongst our own population, we may fairly expect to purchase an increased feeling of stability with regard to our country and its institutions, at home and abroad, in time of peace and in periods of war, which will have more than a money value; we may hope to avoid those occasions of panic which have recently been too much in fashion amongst us; and we may feel confident, that there will be an augmentation to the capital of the country, which will cause such a sum, great as it is, to appear even small by comparison.

Now, the expected possession of a force of 100,000 * effective volunteer riflemen and artillerymen, and the probable expenditure of a large sum of money upon fortifications, have an important connection, both with our subject of to-day and with each other. Twelve months ago, it appeared to be useless, if not worse than useless, to construct permanent works on a large scale for the defence of the country. It was clear, that, in the event of an invasion, when they would have been most required, we must mainly have garrisoned them at the expense of our army in the field, from which not a man could have been spared. At that time, when it appeared so unlikely that we should obtain, either the money required for the construction of necessary works of defence, or the garrisons with which to man them, it was impossible to take that interest which we feel at present in the details of the question.

But circumstances have most materially changed. We could not have better garrisons for our works than effective infantry and artillery volunteers; and no better situation for the action of a proportion of these volunteers could be presented, than behind the parapets which are about, we will hope, to be constructed. In such positions, they would not only be themselves of essential service, but they would also liberate nearly the whole of the regular troops and militia for active service against the enemy.

Seeing then, that there is now a fair prospect, both of works for the defence of the country and of garrisons to put into them, we may proceed, with a practical object in view, to consider the principles upon which those works should be constructed.

Military tactics and the science of fortification are alike dependent upon the weapons employed. The former must always be guided in its rules of action, the latter in its principles of construction, by the effects of those weapons; but alterations in tactics may be effected by degrees. In field operations, experience, however dearly bought, may be gradually acquired. A general who best foresees necessary changes, and troops who are best prepared for them, are no doubt possessed of great advantages, and must, *cæteris paribus*, be in the first instance victorious; but still, commanders and troops may all learn from one another, and may more or less modify their movements and their operations, from time to time, according to the lessons which they receive.

With fortifications the case is different. The engineer is required at once to construct new works which shall be well adapted to future circumstances. He has nothing to guide him but his own studies and reflections, and such applications as he can make of the experience of the past to the probabilities of the future. He is called upon to lay out works which shall be available

* Since happily swelled to 150,000, and upwards.

for future generations, as well as for his own time; and he is expected to adapt his works for the use of, and for defence against, weapons whose powers are as yet but imperfectly known.

It is not indeed of such importance as it would appear to be at first sight, that he should be acquainted with the precise effects of the weapons which are being introduced. He must not limit himself too narrowly to the consideration of the powers which have been displayed by them up to the present time. He must so contrive his works, as far as in him lies, that they may best be prepared to resist the effects of these weapons, and to be defended by them, when they are brought to the greatest perfection to which they can be expected ultimately to attain, in penetrating into, or in destroying, iron, masonry, and earthwork.

In discussing these very important questions, I propose, to commence with a brief sketch of the history of fortification up to the present time; to consider next, what effect improved weapons may be expected to produce on the works now existing; and to suggest, finally, certain principles of construction which appear to be well adapted for future employment.

The object of fortification, as every one knows, is to enable an inferior to resist a superior force; and the means now employed to attain that object, are similar in kind to those which were made use of in the earliest ages. For more primitive and less durable works, earth and timber have always been available; and earthen mounds, wooden palisading, abattis, wicker-work, and so forth, were accordingly turned to account. For works of a more permanent character, and for those intended to be secure against escalade, superior positions were generally selected; walls or ditches, or both, were combined with such natural obstacles as these positions afforded, with a view to the shelter of the defenders, and the destruction of their enemies.

The science of fortification at the present day consists, in like manner, in the choice of suitable sites, where opportunity for choice is given; in the judicious application of mounds, walls, and ditches, to particular situations; and in their adaptation to modern weapons, of which they ought equally to resist the effects, and to facilitate the employment.

Examples illustrative of ancient fortification are shown at figs. 1, 2, plate I., and fig. 1, Plate III. In the first of these figures may be seen a wall, with a ditch in front of it, and a parapet on its summit. In the second is shown a parapet, advanced forward, as it were, on the top of the wall. This advanced parapet afforded a means of discharging missiles, not only from the opening A, in the top of the parapet, but also from that marked B, through which the ditch and the bottom of the wall were seen, A chamber, such as is shown at C, was sometimes constructed also on the level of the ground, and missiles were projected from it to the front. These walls were from 30 to 100 feet high, and from 6 to 12 feet thick. They were constructed, sometimes with brick laid in mortar or bitumen, sometimes with stones of enormous dimensions.

The way in which the walls were disposed in plan, is shown in fig. 1, Plate III., together with the towers, which were added, for strengthening and defending them. They were from 70 to 200 paces distant from each other, and were chiefly round; but they were sometimes square, as at Pompeii, and sometimes polygonal. They varied in height. At Carthage

they were 60 feet high, 15 feet above the walls. At Nineveh they were 100 feet higher than the walls, and they measured altogether 200 feet from their bases to their summits. They were commonly 30 or 40 feet in diameter.

At Jerusalem, Carthage, Rhodes, and other places, double or triple walls were employed, for greater security; and at Ecbatana, the capital of the Medes, there were seven walls. The outer one, two or three miles long, was white; the second was black; the third, purple; the fourth, blue; the fifth, red; the sixth, silvered; and the seventh, gilded. Each of these was higher by its battlements than the one in front of it, and the whole must have furnished an astonishing example of luxury in fortification.

I should not omit to mention here, also, the walls of Great Britain and China.

The former, 12 feet high and 8 feet thick, was constructed in the beginning of the third century. It was 74 miles long, with battlements 4 feet high, and was defended by means of 18 stations, about 4 miles apart, each accommodating 600 men; 81 castles, less than a mile apart, each garrisoned by 100 men; and 330 watch-towers, or turrets, each containing a few men. The latter, 20 feet high, and 14 feet thick, was built upwards of 400 years before. It was armed with towers 80 or 100 yards apart. Both of these walls were carried directly over all the obstacles that came in their way.

In the middle ages, the ponderous machines of the ancients were less used, though they were employed during the Crusades; and there were no such fortresses constructed as we read of in the records of earlier times, either in point of extent or of solidity. Cologne, and modern Jerusalem, are the two best examples of mediæval fortification. The walls of the former have been utilised in the works constructed in the present century, which now surround the city; and they are familiar to the English tourist, as well as the castles on the Rhine, and in other places. In our own country there are many exceedingly interesting specimens of mediæval fortification. Amongst them may be particularly mentioned the castles and walls, so well known, of Conway, Carnarvon, and Ludlow. The first of these has round, the second octagonal towers; and the third is surrounded by towers of various forms. The castles of Edinburgh and Stirling, like those of the Rhine, are remarkable for the sites on which they have been constructed.

But, even now, there are lessons to be learned, both from ancient and from mediæval fortification, which should not be despised. In modern fortresses, too much dependence has often been placed upon one defensive line, and the forcing of that one line has frequently led to the capture, or surrender of the place. Unprovided, even with posts of security along that line, fortresses have not only been lost, but the inhabitants have also been delivered over to the excesses of their infuriated assailants, on the occasion of a surprise, of a coup-de-main, or of the storming of a breach.

The ancients provided against such a contingency, partly by rendering their towers independently defensible, and, still better, by the numbers of walls which they constructed one within the other. The architects of the middle ages attained a similar object by their citadels and keeps, or by fortifying the houses within the walls which surrounded their towns.

The want of permanent internal works of an analogous description, also, has caused the surrender of many a fortress in modern times, after the for-

mation of a practicable breach, or of one supposed to be practicable, for fear of the consequences that an attempt at prolonged resistance would be likely to entail; and in the present century many plans have been adopted, and very many have been proposed, for remedying the defect that had thus been allowed to creep into the science, and that had been found by bitter experience to be attended with such serious results.

The first shot that were employed, after gunpowder came into use, in the middle of the fourteenth century, were of stone; and these were not very destructive to exposed masonry. A solid tower, at the first siege of Magdeburg, was struck by upwards of 1500 of such cannon balls without receiving material injury. But iron shot proved, at length, to be so formidable, that it was found necessary to sink the walls below the surface of the ground, and to hide them from the view of the enemy. From this time forth, fortification became more and more complicated and difficult; and, if I may use a very simple expression to describe an important principle, it grew to be a game of "hide-and-seek" between the attack and the defence. Walls continued to be, as they still are, in positions where wet ditches are not available, the principal means of security against sudden assault; and one of the leading questions, perhaps the greatest question, that the engineer has since had to solve, is, the best method of disposing his walls, so as to render them available for the objects required, and to place them, at the same time, out of reach of the artillery of the besieger. On the other hand, from the very commencement of a siege, the principal object of the assailant, next to that of forming a covered road, by means of which he may approach the place securely, is to destroy a portion or portions of the wall which prevents him from getting into it.

In order to adapt the walls of fortresses to the use of cannon on the part of the garrison, several changes were found, also, to be required. A larger base was wanted behind the walls, and in the towers, on which the guns might be worked. An earthen, instead of a stone, parapet became necessary, as it was found that the latter was soon destroyed, and that the splinters from it were more hurtful to the defenders than the enemy's shot. The wall itself, as I have already stated, had to be sunk to a lower level, to protect it from distant fire; and, the parapets and ramparts having been thickened, loopholes and machicoulis, in the ancient method, became inapplicable. In many cases, spaces were left between the earthen rampart and the wall, as in the "chemin-des-rondes," afterwards adopted by Montalembert and Carnot. But, generally, a necessity was felt for a better description of flank defence, in order to prevent the employment of explosive mines in the ditch, for blowing up the escarp walls; or the use of ladders, for surmounting them, out of the view of the defenders.

These considerations were at the base of all the methods of construction adopted for the improvement of fortification. And in the modes of the first writers may be recognised, as we shall see, the germs of the discussions, and even of the national predilections, of the present day.

The most noted of the Italian architects of the fifteenth century who paid attention to military engineering, was Francisco di Giorgio Martini. He was born in 1423, and is supposed to have died in 1506. He employed not only the more elementary portions of permanent fortification, such as the bastion and the curtain, but, also, the ravelin, the faussebraie, the covered

way, and other works which have since been re-invented over and over again, and ascribed, at different times, to more recent authors. One of his designs, a copy of which may be seen in the second volume of the Corps Papers of the Royal Engineers, contains the ideas which have been carried out in the present century in Germany, of a polygonal trace with caponier defence.

The origin of bastions is now involved in obscurity. They are said to have been first used by a Turkish general, at the siege of Otranto; and it has been supposed that the idea of a bastion was first given by a square tower placed obliquely for flank defence against a wall, in the manner shown at K in Plate III. fig. 1. The first large bastion is stated to have been built at Turin, in 1461; and San Michaeli constructed that of the Madeleine, at Verona, in 1527.

Tartaglia and Marchi followed in Italy. The former has generally been erroneously supposed to be the inventor of the covered way. The latter claimed the invention of 161 systems, and gave all the outworks of more modern systems. His writings were commenced in 1546, and were printed in 1599.

The first German author on fortification, was the celebrated engraver and painter, Albert Dürer, who published, in 1527, the work entitled, "Underricht von Befestigung der Stett, Schloss, und Flecken." For permanent works, he proposed, in the first instance, round bastions of huge dimensions, in lieu of the old flanking towers. His embrasures for artillery were nearly on a level with the bottom of the ditch, and were provided with shutters, loop-holed for small arms. After finding that the expense of the enormous works which he proposed to build in masonry, would be too great, he devised earthen ramparts and escarps, with openings below for artillery. His circular system contained a double enceinte of masonry, with caponiers for the defence of the ditches, and is shown in profile in Plate I. fig. 3. His system on a square consisted of three earthen ramparts, one behind another, such as have recently been proposed by Mr. Fergusson in this country: the interior rampart was 60 feet high, and was flanked by caponiers. He provided casemates for guns, bomb-proofs for troops, and an independent defence for his bastions; precautions, the necessity for which was at first exaggerated, but which were afterwards too much neglected.

San Michaeli also built in the first instance, round, casemated flanking batteries for the service of guns, in some parts of Italy; but he afterwards constructed, in preference, low flanks, retired behind orillons of masonry, which were rounded at their extremities to resist artillery fire. The fire of shells at high angles of elevation was at this time coming into frequent use in sieges, and was demonstrating the necessity for placing men and guns under cover; and these two men, in their respective countries, naturally adopted the means which seemed best adapted for such a purpose.

A German author, Speckle, published a work on the "Architecture des Forteresses," in 1589, when fifty-three years of age. He asserted that he could give upwards of fifty different methods, all of them good; but he refrained from describing more than eight. He made, however, great improvements in the science, and forestalled the inventions of many of the engineers who came after him, as he also borrowed some from those who went before him.

He increased the size of the bastions. He recognised the importance of placing the flanks at right-angles to the lines of defence, which the Count de Pagan got credit for half a century afterwards. He added casemated galleries, after Dürer, to obtain a low sweeping fire through the ditches, and prevent the action of the miners. He enlarged the ravelins, a measure for which Cormontaigne received praise 140 years later. He increased the places of arms; an improvement which Vauban subsequently made in Pagan's system with great *éclat*. He employed the fausse-braie. He proposed those counter-arched revetments which were afterwards invented and claimed by Du Vivier, Coehorn, and Trincano; and which are now considered to be the best form of retaining walls that can be adopted. He used triple flanks, which were afterwards adopted by others, and notably by Choumara in the present century.

In his publication of 1564, Castriotto advocated large bastions with triple flanks, and with caponiers. He proposed also a system similar to those which were afterwards constructed by Vauban, and were called the second and third systems of that eminent engineer.

In 1594, the first French author on fortification, Erard, de Bar-le-duc, published a work in which he advocated a modification of the Italian methods; but he was far from happy in his ideas, for, in his desire to protect his flanks from the fire of the enemy, he rendered them all but useless for the purpose for which they were intended, of defending the escarps and ditches.

Marolois reduced to a system, and published in 1627, the Dutch mode of fortification, with earthern ramparts and broad wet ditches. The third system of Coehorn, who has been termed, in consequence of his eminence, the Dutch Vauban, is shown at Plate III. fig. 6. Coehorn's last writings were published A.D. 1741.

Italian engineers came into great request in the 16th century in Spain and the rest of Europe; and their bastioned systems were generally adopted, though with various modifications. They were constructed at first with small bastions and long curtains; and the ditches were defended, according to San Michaeli's method, by low, triple flanks, protected by orillons. The existing fortifications at Berwick-upon-Tweed, though unfinished, and in a ruinous condition,* are an interesting example of the early Italian systems: an illustration of the principles on which they were designed may be seen, in plan on Plate III. fig. 2, and in section on Plate I. fig. 4.

Casemates fell into disuse after a time, on account of their expense, and the alleged difficulty of ventilating them; and the question of casemates *versus* no casemates, has continued to be much discussed, even in the present century. The French, adopting the views of the Italian engineers, assert that the Germans employ these auxiliaries too much; and the Germans, on the side of Dürer, accuse the French of not making sufficient use of them. The Germans employed casemated cover for large proportions of their garrisons in their fortifications of the 16th century, as at Küstrin and Spandau; and they have latterly done so to a still greater extent. The French have not, until recently, availed themselves so much of permanent

* It is said that the modern fortifications at Carisbrook Castle, in the Isle of Wight, also constructed in the time of Queen Elizabeth, are similar in plan to those at Berwick-upon-Tweed.

cover in their fortresses, but they appear to have seen the necessity for it of late years. As an illustration of their more recent ideas in this respect, I may mention, that the fort of Mont-Valerien, near Paris, contains complete bomb-proof accommodation for 4,500 men, with their stores and materials. National character, as I have already hinted, has no doubt had much influence in producing the differences in theory and practice which have existed between the French and German engineers on these subjects.

Fortresses, however, in the sixteenth century, required to be modernised rather than to be constructed; and, accordingly, bastions were added in front of the old walls and towers, and demi-lunes, or semi-circular works, were placed in front of the gates of the towers and cities. These latter came to be considered, before the middle of the seventeenth century, as integral parts of the bastioned systems. San Michaeli was thus employed to modernise the fortifications of his own country, but his best-known works can hardly be said to have been of permanent utility to it; and they do not in this respect afford a good example to the advocates of the science. He would, perhaps, have preferred to leave his native city, Verona, without bastions, and his *chef d'œuvre*, fort Lido at Venice, unconstructed, if he could have looked forward into futurity, and foreseen the work that they were destined to perform. It will be remembered, that these very fortresses, instead of affording a means of defence to Italians, have, in their modified condition, actually preserved the Austrians, during the past year, from Italian liberators and their allies.

It will be impossible, within the limits here prescribed, to attempt to allude to more than a very small proportion of the systems of fortification that have been put forward during the last 400 years. It has been stated that there are upwards of 500 of them, and it is probable that that number is by no means an exaggeration. Deville, the next French author on the subject, (after Erard,) was not more successful than his predecessor. The first French systems worthy of notice, were that of Marshal Count de Pagan (shown at Plate III. fig. 3), and those which have been called after the great Vauban, and designated as his first, second, and third systems. But this latter engineer, though he constructed 33 fortresses, and strengthened 300 others, invented no systems himself, and disclaimed having done so. He adopted and simplified the ideas in fortification which were handed down to him, and applied them, as best he could, to the different places which it became his duty to fortify. His first system (Plate III. fig. 4) is perhaps better known than any other. It was taken by his followers as the average mode of construction which he employed at several places. It consisted simply of a bastioned front, with a ravelin and tenaille, (and caponier, when the ditch was dry,) in the ditch; and a covered way behind a sloping glacis. He placed the flanks at right-angles to the lines of defence, an invention which has generally been ascribed to Marshal Pagan, the distinguished French author (of the seventeenth century) above referred to, but which appears to have been due to Speckle, a German author, to whom I have also alluded, as having written half a century before his time.

The tenaille, which was constructed in the main ditch, in front of the curtain, to protect the escarp of the curtain and flanks, has been ascribed to Vauban, but it was previously invented by Castriotto in 1564; and it was somewhat after the fashion of the middle flank of Rimpler, 1673.

The ravelins were originally intended to protect the principal entrances to the place, and were made in the form of a crescent. They received for this reason the name of demi-lune, which they retain to this day amongst the French. Straight faces and ditches were afterwards given to them, in lieu of their semicircular fronts, in order that the ditches might be better protected by a flanking fire from the main ramparts, than was possible when they were curved. The want of a covered way was conspicuously shown in 1529, at the siege of Vienna, when the Turks forced the garrison, after they had made a sortie, into the ditch. This work was mentioned (after Martini) by Tartiglia, in 1546, and is said to have been first adopted in the Castle of Milan.

The so-called second system of Vauban, is taken from the fortifications which he constructed at Belfort and Landau; the third, which is very similar to it, and which is given in Pl. III. fig. 5, from those of Neuf Brisack. In these he employed detached bastions, with "tower-bastions," as they have been termed (T T in the figure), connected together by a curtain behind them. At Neuf Brisack he broke up the curtain, in the manner also shown in the figure, to obtain a better flank defence. The ideas of detached bastions and broken curtains were published by Castriotto in 1584, and by Marchini in 1599. Zanchi was, however, the proposer of the true tower-bastions, those of Castriotto having been round.

Cormontaigne and others, after the death of Vauban, which occurred in 1707, took his first system as the basis for further improvement; but Choumara, writing in the present century, considers this to have been a mistake. It is said that they rejected the tower-bastion method, in consequence of its not having proved successful during the defence of Landau in 1713. After several others of the same name, the French engineers arrived at a system which bears to the present day the name of the modern system. It is shown in plan, in Plate III. fig. 7, and in profile, in Plate I. fig. 5. It had a ravelin of greater size and saliency than that of Vauban, in order that the besiegers might be delayed in their attack on the covered way in front of the bastions, and might find it more difficult to enfilade the faces of the bastions. There are, as will be seen by the diagram, a large redoubt in the ravelin, and a ditch, or *conpure*, across the faces of the ravelin, to prevent the besiegers from passing, without impediment, by sap, along those faces, and taking the redoubts which are placed in the re-entering places of arms, in reverse. A permanent intrenchment to the bastion, also shown in the diagram, was added by Cormontaigne, in order that, when the bastion was breached by the besiegers' artillery, from the counterscarp opposite the salient of the ravelin, the interior of the place might not be thrown open, or its safety be dependent upon a temporary intrenchment, thrown up under circumstances of difficulty, and under the enemy's fire.

Such are the principal features of the last "modern system;"—a system which has many serious defects. Its long lines, projecting towards the country, are liable to be enfiladed, including the faces of the ravelin and its redoubt, the flanks of the bastions, and, at times, even the faces of the bastions. It is wanting in secure casemated fire for the defence of its ditch, as the flanks of the bastions, which constitute its principal means of defence, may be counter-battered by the besiegers, even from a distance. It is expensive to construct, and affords no bomb-proof accommodation for its

garrison. The masonry, as will be seen by its profiles, (Plate I. fig. 5,) is only of use in affording security against escalade as long as it is uninjured. The shoulders of the bastions may be breached from the salient of the ravelin; and certain portions of the ditch, in front of the curtain and the tenaille, are unprovided with defence, as they cannot be reached by the fire of the garrison.

Various means have been proposed for the remedy of these defects, by Bousmard, Chasseloup-de-Labat, Noizet, Dufour, Choumara, and General Haxo.

The detached ravelins, casemated tenailles, and bastion retrenchments, of Chasseloup and Bousmard, have, no doubt, merit; but, for the curved faces and flanks of the bastions of the latter, the same cannot be said. A diagram of the system proposed by the latter author will be found at fig. 8 of Plate III. The two main principles advocated by Choumara, of an interior glacis in front of the escarp, and of rendering the parapets and escarps in certain cases independent of each other, might to some extent be advantageously adopted in any future employment—if it were desirable—of the bastioned systems, and may be made available in other systems. The latter principle has been adopted to a limited extent in some of the forts which are now being constructed in this country. A glance at Plate IV. fig. 14, will show that the face A B, and the ditch before it, have been drawn—not parallel to one another, as they would have been made according to previous ideas—but each in the direction considered to be most suitable to it. The face is intended to deliver its fire to the greatest advantage over the country in its front; the ditch, to be flanked by the caponier at the salient of the work. In figs. 11, 12, 13, 14, of Plate II. may be seen the different proposals of the same author for improving the profiles of his works, which are suggestive, and worthy of consideration, though they are not, for the most part, applicable in practice. The interior glacis is shown in Plate II. fig. 12.

The closing of the opening in the main ditch, caused by the ditch of the ravelin, by means of large redoubts at the re-entering places of arms, as proposed by Noizet and Dufour, is an obvious mode of remedying that defect. The casemates of Haxo, which consist of brick, or masonry arches, covered with earth, thrown over the guns, have already been much used, and are probably destined, with modification, to be extensively employed in future works.

But changes of a more radical nature than those above indicated, have been advocated by the illustrious Marquis de Montalembert, and by the celebrated Carnot, who were brought up, the former as a French dragoon, the latter as a French engineer; and it is right to add, that the ideas of the engineer were in some measure derived from the writings of the dragoon.

Montalembert expended a great part of his private fortune in the publication, in 1776, of the elaborate work, a copy of which, belonging to the library of the Institution, you see before you. Carnot was employed by Napoleon to devise the best means that he could, for improving the strength, and prolonging the defence, (in case of attack,) of the numerous fortresses which the French had acquired in the course of their conquests.

The leading principles of Montalembert were:—first, the employment of a central caponier, in lieu of the flanks of the bastions, for the defence of the

main ditch,—a method which was alluded to in an anonymous work published by Pfeffenger at Amsterdam in 1698, sixty-eight years before, as having been then practised; and, secondly, the multiplication of masonry casemates, and artillery fire. He proposed by these means to correct the acknowledged defects of the "modern system," and, by bringing ten guns to bear upon any one which the besiegers could employ against him, to render a siege impracticable. Montalembert thus estimated with too liberal a mind the offensive means which it would be practicable to place at the disposal of his garrison; and he undervalued the effect upon masonry, of even an inferior fire on the part of the besiegers. A profile of his circular system, illustrative of the mode in which he proposed to carry out the latter principle in that system, is shown in Plate I. fig. 6.

Carnot proposed several systems, including a circular system, as many others,—Dürer, 1527; Bilfinger; Franki; Steuber; Pirscher, 1767; Schneider and Cugnot, 1778; Lansberg, 1712—37; Voigt, 1713; Harsch, 1719; and Montalembert, 1793,—had done before him. His leading idea was, to prolong the defence of a fortress by an increased use of the vertical fire of mortars, from which he intended to shower musket-bullets upon the heads of the besiegers; and, either to destroy them, or to render their trenches untenable. He proposed to protect his mortars by casemates, after a plan which had been given by Speckle in 1589. Secondly, he placed a detached wall in his ditch, separated from the ramparts, and covered by a counterguard of earth in its front. Thirdly, he advocated the use of a countersloping glacis, to facilitate sorties; an old expedient of Belisarius, when he was besieged in Rome by the Goths. Carnot proposed, by the frequency of his sorties, to oblige the besiegers continually to keep large bodies of troops in the trenches; and he intended to destroy those troops by the fire of small projectiles, which were to be continually rained down upon them from his mortars.

These were formidable arrangements, but they were not calculated to be successful in practice. It has been shown by Sir H. Douglas, that Carnot over-estimated the probability of hitting the besiegers with his showers of small bullets; that, even if he had been able to strike them as frequently as he expected, he would not have done them much harm; that, at all events, a leather or wicker helmet would have protected them from their effects; that he would have exhausted any moderately numerous garrison by a too frequent employment of sorties; and that his detached wall was not secure against the distant fire of the besieger. A profile of Carnot's third system is shown at fig. 7, Plate I.

These principles of Montalembert and Carnot have been extensively adopted in the fortresses which have been constructed in Germany during the present century.

There is an excellent model of the "Prussian System" in the Military Model Room of the Institution; but, for present reference, there will be found in Plate II. figs. 8 and 9, illustrations in section; and in Plate III. figs. 9, 10, 11, illustrations in plan, of the polygonal systems adopted by the Germans from the ideas of Montalembert, showing the central caponiers, the detached walls, and the countersloping glacis, to which reference has been made.

The German engineers, themselves, have told us but little about their

works; and they guard the entrances to them with a care which deserves a better result than they have obtained; but other nations are well provided with plans and sections of them, and have acquired a considerable amount of information about them. To obtain the requisite knowledge, it is stated that two French engineer officers worked as stonemasons at Fort Alexander, at Coblentz, for some months. The best account of that fort has, however, been given by an English officer, Colonel Humphreys, who resided for some time in the neighbourhood.

The principal German fortresses that have been constructed, or remodelled, since the peace of 1815, are:—in Prussia, at Coblentz, Cologne, Posen, Thorn, Königsberg, and other places; in Bavaria, at Gemersheim and Ingoldstadt; by the German Confederation, at Mayence, Rastadt, and Ulm.

In the construction of these fortresses, casemates, for artillery fire and bomb-proof cover, are extensively employed. By a multiplication of tiers of guns, greater offensive power is in some cases aimed at. The polygonal trace is adopted, in which the forms of the ramparts approach nearer to straight lines than in bastioned systems. The main ditches are defended by casemated caponiers, either separated from, or attached to, the body of the place. Advanced works are placed in front of the principal lines of defence, to command a greater extent of ground, and to delay the besieger. The ditches of these advanced forts are flanked by caponiers, bastionets, or escarp or counterscarp galleries, as well as the smaller ditches of the main fronts. Defensive, bomb-proof barracks, of proportionate size, are added in the rear of the larger, and bomb-proof redoubts, of more limited dimensions, in rear of the smaller works. The use of countermines has been extensively adopted, and most judiciously so, because, wherever they exist, they compel the besieger to approach the works attacked by very slow degrees. Each smaller work, and each portion of the larger works, is designed with a view to independent defence; and they are all, more or less, combined in a system of general support, so as to favour an active defence.

Whatever the defects of the German works, this last principle, at all events, is a highly important one, and is greatly to be commended.

A *step-by-step* resistance is aimed at, increasing in efficiency in proportion to the strength and resources of the garrison. I shall have occasion to point out presently, how the masonry may in some cases be ruined from a distance; and that this is a defect which should be remedied. But the idea is not the less good, and is the same that has been advocated notably by Choumara, in reference to bastion fronts. It is this—that the besieger should be delayed by successive obstacles; that after approaching one, by the slowest process of sapping and mining to which he can be reduced, he shall have to do the same by the next, and the next, and so on, to the defensive barracks in the interior of the main fortress.

These principles are differently applied in the various fortresses referred to, partly to suit the situations and circumstances of each particular case, partly to adapt them to works previously in existence, and partly, as it would appear, to suit the ideas of those by whom they have been constructed.

It will not be possible now to go in detail into the question of their various adaptations, or their relative merits; but I will just refer briefly to

Verona, as having been of recent interest, and to Lintz, as being an exceptional fortress of an extraordinary character.

At Verona, detached walls have been added to the original bastioned trace, with a countersloping counterscarp opposite the curtains; and round towers of masonry have been placed in advance. It was reported towards the close of the late war in Italy, that the Emperor of the French proposed to carry Verona by assault. This would not have been practicable without the previous action of artillery; but it is probable that he intended:—1. To ruin some of the masonry towers in advance of the place by means of his rifled guns; 2. To breach the detached walls, by the method shown in Plate II. fig. 17, and to batter the earthen slopes, of the main rampart; and, 3. To attempt to carry the main defences by assault. I shall say more presently, with regard to the practicability of the two first of these measures. In the meantime, I may remark, that the fortress of Verona, in combination with the other fortresses in its neighbourhood, certainly served admirably the purpose for which it was intended, that of receiving, when necessary, and giving protection to, a beaten army; and that, whatever the defects in the details of its construction, its position proved to be of the utmost advantage to the Austrians in the operations referred to.

At Lintz, masonry towers, invented by the Archduke Maximilian, have been constructed about a quarter of a mile apart; but, to render the position tenable by any garrison but a very large army, they require to be protected by earthwork, and to be connected together by continuous works. There is a most interesting model of Lintz, and the surrounding country, in the Institution, which has been contributed by Captain Stavely, late of the Royal Engineers; showing the position of these towers, and illustrating the strategical fortress which they are destined to form. The principal feature connected with the design of the towers is the arrangement of the gun carriages, by which the Archduke Maximilian expected to obtain a heavy concentrated fire upon any required point; but experiment has already demonstrated how easily the towers, in their present form, may be disabled, and how readily the guns may be silenced; and the construction of these towers cannot be considered in any other light than as a great, and an expensive mistake. Vast additional works must be undertaken in connection with them, before the position can be rendered formidable to an enemy; and their destruction would, in their present unprotected condition, be the more easily effected, now that rifled guns, capable of being worked and transported with increased facility, and firing at longer ranges and with greater accuracy, are coming into ordinary use.

In the fortresses above mentioned, what may be called the modern German principles of fortification have been more or less carried into practice. Time will not permit me now to do more than make a general comparison between the principles on which those works have been constructed, and those which have been employed of late years by French engineers; but such a comparison is, in fact, the great fortification question of the present day, and has formed the principal subject of discussion between continental writers. The Germans have adopted principles, as we have seen, that Frenchmen have advocated, but that are different from those on which French engineers have mainly acted. The French still uphold the bastionary, and assert that it is superior to the polygonal trace; while the Germans have

applied the latter trace; and, in thus carrying out some of the suggestions of Montalembert, have met with more approval, and have been more followed in Europe generally.

The French, in fortifying Paris, employed, after much discussion, a continuous, bastionary enceinte, surrounded by advanced bastioned forts; and Paris may be taken as a type of modern French fortification.

At Grenoble, Belfort, Besançon, advanced forts have been added, and these places have been converted into vast strategical fortresses. At Lyons, the French have also used a bastionary enceinte, and have placed ravelins in front of it; but in some of their advanced forts at this place they have made use of a polygonal trace, with caponiers and interior redoubts, in a manner that has induced the Germans to claim them as partial converts to their principles.

The principal defects which the Germans, following Montalembert, allege to exist in the French bastioned trace, are briefly these:—

1. A want of artillery fire from casemates.
2. A loss of interior space, in consequence of the curtains being retired for so considerable a distance behind the bastions.
3. An unnecessary restriction to the length of the lines of defence.
4. An inferiority of space for direct artillery fire, as compared with that which may be obtained by the employment of the straighter fronts of the polygonal trace.
5. A want of good interior defence, and of the means of establishing it.
6. A liability in the parapets of the flanks to be destroyed before they are wanted, at the later periods of an attack, to defend the ditches.
7. A want of defence for certain portions of the ditch, when a tenaille is employed.

The French, also, assert that the following defects exist in the German applications of the polygonal trace:—

1. The casemates are too numerous, and cannot be properly ventilated.
2. The masonry would be destroyed at an early period of the operations.
3. It is expensive to construct.
4. The splinters from the masonry would be very hurtful to the besiegers when under fire, and therefore detrimental to the defence.
5. Employment in the casemates weakens the courage of the soldier.
6. The escarp walls are not flanked from the body of the place, but the defence of the ditches is obtained by means of caponiers, and works more or less separated from it.
7. The central caponiers might frequently be destroyed by distant artillery fire; and, even if they were battered from one side only, the defenders would suffer, in many cases, on the other side also.
8. The other flanking defences would also be liable, in many cases, to destruction from distant fire.
9. The detached Carnot walls, where these are employed, and other parts of the masonry, would suffer in a similar manner.
10. Longer lines are exposed to the effect of enfilade fire in the polygonal, than in the bastioned trace.

I shall have more to say on some of these questions as I proceed, further on, to consider how far either of the systems referred to are adapted for

future use. In the meantime, you will observe that the principal questions between the French and German advocates, are—

1. The more or less extensive employment of casemated fire.

2. The relative advantages and disadvantages of bastions or caponiers for flank defence, and in other respects.

3. The relative liability of the polygonal fronts, or of the faces and flanks of the bastions, to enfilade fire; and the possibility of directing these, respectively, upon points from which they cannot be enfiladed.

You will observe, also, that they have entirely agreed, in their practice, upon one point. Whatever the forms that they have employed in their fortresses, they have surrounded their main lines of ramparts, in all recent cases, by detached forts; and they have, in their larger fortresses of recent construction, more or less abandoned the use of outworks in favour of these detached forts. They have thus alike made preparations for defending a greater area of surface with an increased use of artillery, at the same time that they have provided, to some extent, against the employment of more effective and longer-ranging weapons in the attack; and they have anticipated in this manner the progress of modern weapons, and the requirements of modern warfare. They have only done so, however, to a limited extent, because they were unable, of course, to foresee the degree of perfection to which rifled guns and muskets were destined so soon to attain.

At the same time, these modern fortresses show the general tendency of ideas to be now in favour of extensive strategical positions, in place of isolated fortresses of limited extent; and, when properly armed, manned, and provisioned, they will no doubt have great advantages over those of older construction. They are more or less fitted for the reception of a beaten army, which may take refuge in their neighbourhood, or within the area of their works,—which may gain time for recruiting its numbers and resources,—and which may resume the offensive at the proper moment. They oblige the besieger to commence his operations at greater distances from the main works, and thus delay the operations of his attack. By causing him to extend his forces over a greater surface, they compel him to employ larger forces, or to be exposed to attack himself, by superior numbers, at any given point.

I cannot now allude more particularly to the subject of fortification with wet ditches, or to the system of Mr. Fergusson, which has, within the last ten years, excited some attention in this country, though I hope to do so, in this place, on the 21st of May next.*

In the meantime, having glanced rapidly over the history of fortification, and having brought it down to the present time, I will next proceed to inquire what the effects will be, in practice, of these new rifled weapons, and what additional power they will be likely to confer upon infantry and artillery, as far as that science is concerned.

In the first place, it must be remembered, that their *maximum* effect will be made available, and will be experienced, in the attack and defence of fortified places. In the field, there will always be more or less of difficulty in obtaining, just when it is required, perhaps on unknown ground,

* The Lecture on this subject has been already printed, and will be found at p. 198, Vol. IV. No. XIII., of the Journal of R.U.S. Inst. *et seq.*

the range of the objects to be fired at; and more particularly so when these objects, as is frequently the case, are in motion. The longer the range employed, the greater will be this difficulty; and when the range has been accurately discovered, the object fired at, such as a body of troops, may often be moved out of the way, into a place of concealment, or a position of greater security.

In this case, also, the aim of the contending parties will not be so good when cover cannot be found for men and guns. Artillery will be liable to suffer severely, both from sharpshooters and from opposing artillery; and masses of infantry will be under a similar disadvantage in the generality of cases.

But, in the course of a siege, besiegers and besieged are firing at each other on the same ground from day to day, for the most part at well-known distances, the artillery from behind parapets, the infantry from such shelter as the site affords, or from trenches and pits constructed for the purposes of attack or defence. Artillery and infantry will both require, and will no doubt obtain, better cover in future than they have hitherto been provided with; they will thus be able to employ their weapons from places of comparative security; and they will be placed under the most favorable circumstances that hostile operations can afford, for using the superior weapons which will be supplied for their use, with great accuracy, at long, as well as at short ranges.

The defence has hitherto had one advantage over the attack, in that the besieged have been able to employ guns of larger calibre, and thus to obtain longer ranges, and greater accuracy of firing, than the besiegers; but the introduction of rifled ordnance has deprived it of this advantage; and it will in future be desirable to employ, on the side of the defence, a greater number of lighter guns; these guns being now capable of almost all the range and accuracy that can be desired, being more easily manned and worked, and being available for more frequent use with a less expenditure of ammunition.

The heavier guns will now be principally required on the side of the attack, to level the earthwork, and to ruin the masonry of the place; whilst lighter guns will be employed by the besiegers, against mantlets, for silencing and dismounting the enemy's artillery, and, to some extent, for the purposes of enfilade and ricochet fire. Lighter guns will, for the most part, suffice, in combination with musketry, on the side of the defence, for opposing the progress of the trenches, the batteries, and, generally, all the surface works of the besieger; and they will only require occasional assistance from heavy artillery, when the destruction of any of those works, after their completion, or their partial completion, is to be attempted.

It is evident that, by the employment of rifled guns of the heavier calibres, the besieger will be able to destroy all the ordinary defences of a fortress that are exposed to his fire, with greater facility, and from greater distances, than before. We have still much information to acquire in regard to the relative penetration into earth and masonry, at different distances, of round and elongated projectiles; but we know the accuracy with which the latter may be thrown; and we can foresee, without difficulty, that the aggregate effect of a given number of shot will be materially increased, for this reason, at anything but short ranges.

Elongated missiles from rifled guns, though capable of greater range, by

virtue of their increased momentum and greater accuracy, have at the same time, however, two disadvantages. They leave the mouths of these guns with a comparatively low velocity; and their long axes retain, during their flight, the angle to the horizon at which they are discharged. At short ranges, they are therefore wanting in velocity; and at long ranges, they strike the objects at which they are fired at a greater or less angle, according to the degree of elevation given to the piece. Their powers of penetration are thus less than they would otherwise be, both at long and at short ranges. They retain their velocity, however, better than short or spherical projectiles, at long ranges; and they can be made to strike a particular part of any object, at far greater distances, and with much greater accuracy; and, for these reasons, they will be able to provide a distant fire of a more destructive character than any that has previously been employed, against ordinary works of fortification.

In breaching a wall at 60 or 80 yards from a battery, there will not be so much difference in the time occupied, whatever description of shot may be employed; and more will depend in that case, if the masonry be solid, upon the calibre of the gun, than upon the shape of its bore or the form of its projectile; such difference as there is being in favour of the smooth-bored gun. In firing at short ranges into earth-work, or into slightly built escarps, the superior shell-capacity of long missiles, will, on the other hand, be in their favour, as increased effects cannot but result from their explosions.

At what we have hitherto been accustomed to consider as long ranges, parapets of earth will then be more easily blown away by the accurate fire of shells, and masonry will be knocked to pieces with greater celerity and certainty, whenever it is visible from the exterior. Those effects, also, the besieger will be able to produce by means of guns scattered about in suitable positions in the neighbourhood of a fortress; secure, by their distance from the besieged, from sudden assault, more or less independent of the other works of the attack, and difficult to be silenced by the fire of the garrison, or even, in some cases, to be discovered, except by the flash and smoke of their explosions.

Improvements in manufacture, and in the means of locomotion and transport, are progressing together at so rapid a rate, that we must be prepared, not only for the action of superior weapons, but also for the employment of greater numbers of weapons; and the means of destruction at the disposal of the besieger will thus be still further augmented.

At the same time, the peculiarities above referred to, which attach to elongated projectiles, render them comparatively powerless against any material which is inclined at a small angle to the horizon; and gentle slopes of earth, as well as steeper slopes of granite, and perpendicular masses of iron, may be made to offer a good resistance to them when they are judiciously employed.

What I have hitherto said, has reference more particularly to those works of a fortress which are visible from the exterior; but I must now speak also of the masonry, which, not being visible to the besieger, may yet, when its position and form are accurately known, be exposed to the destructive action of his artillery fire.

In the year 1824, there were some experiments tried at Woolwich, upon

a detached wall, such as had been proposed by Carnot, as I have already explained, for the defence of the ditches of fortresses in place of escarp walls The object of these experiments was, to ascertain whether a practicable breach could be made in a wall of this description without its being seen; and the nature of them will be easily understood by a reference to fig. 17, Plate II., in which the experiment is represented in section. A detached brick wall, 30 feet long at the bottom, and 28 feet at the top, was carefully built in 1823. It was 21 feet high, 6 feet thick at the top, and 7 at the bottom. It was strengthened by a buttress, four feet square at each end, and was weakened by one loophole, in a recess. It was protected in front by an earthen mound, in the form of the counterguard proposed by Carnot, 60 feet distant from it.

A year after the completion of the wall, eight 68-pounder carronades, at 500 yards, and three 8-inch and three 10-inch iron howitzers, at 400 yards from the counterguard, opened fire upon the wall, with solid shot, and live shells, respectively. A practicable breach, fourteen feet wide, was made in the wall, in six hours, and the buttresses were much injured. During that time, 100 rounds per piece, or, altogether, 1,400 rounds, were fired.

The firing was continued on subsequent days, until the wall was a complete ruin. It has been stated that this experiment was not fairly made, and that the effect of each shot was reported to the battery, to enable the elevation of the guns to be the better adjusted. But in the official report of it, published by Sir Howard Douglas, it is stated, that the guns "received no aid, as to charge, direction, or elevation, beyond what real service would afford."

A few years since, also, some experiments were tried in Germany, upon a casemated guard-house at the rear of an earthen work. The wall to be struck was 39 feet long, 15 feet high, and 5 feet thick; and it was strengthened at the ends by two side walls, 6 feet thick, and in the middle, by a pier, 4 feet square. It was pierced with two embrasures. The arches above it were 3 feet 6 inches thick, and had 5 feet of earth over them. The whole was built of clay-slate, laid in good mortar, except the arches, and the lining of the embrasures, which were of red brick.

It was protected by an earthen parapet, 108 feet in front of it, and 3 feet higher than the masonry of which it was composed; and it was thus itself concealed from view, though the earth above it could be seen by the gunners in the battery that was employed for the experiment. That battery was placed 530 yards in front of it, and was armed by iron howitzers, with a bore of 8·4 inches. They were discharged at an angle of elevation of $6\frac{1}{4}$ degrees, with shells weighing 101 lbs. each; and the wall was ruined, for practical purposes, after 400 rounds had been fired.

Lieut.-Colonel Bainbrigge, R.E., by whom this experiment is recorded, states that the effect of each shot was telegraphed during the experiment to the battery. The experiment was not a fair one in this respect, as the artillery had an advantage, in knowing the result of their firing, which they could not obtain in actual service; but, after all, the wall was only struck by 34 out of 112 shells, which were fired at it in two days; and the whole building by 159 out of 400 shells, which were fired at it in four days.

In the Woolwich experiment above referred to, only about one-fifth of

the shot, and one-fourth of the shells, struck the wall; and, to give an idea of the weight of metal that is required to breach an ordinary escarp wall, when it is exposed to view, I may here state, that a rough average of the effect of the breaching-batteries in the Peninsular sieges, as calculated by Colonel Sir William Denison, R.E., shows an expenditure of upwards of 1,000 rounds of 24-pounder ammunition for a breach 100 feet long, made at a distance of 550 yards from the battery.

It would be, of course, far more difficult to ruin an escarp wall, and particularly one which was constructed with arches resting on piers distributed at intervals along its length, or in what is called the "counter-arched" form, than the detached wall destroyed in the Woolwich experiment; and the principal bomb-proof caponiers of the German fortresses would offer a far greater resistance than the guard-house of the work referred to in the German experiment; but there is no doubt, at the same time, that a far more accurate fire may ultimately be obtained from rifled artillery than was available on these occasions. To how great an extent this will be the case, time and experience only can decide; and, in the meantime, the only conclusion that we can safely arrive at, is, that it will not be desirable to construct any walls in future permanent fortifications, when we can avoid it, that are not well protected from distant fire; and that it will be a great advantage, if, without losing efficiency in other respects, or incurring extra expense, we can, not only conceal our walls from view, but also place them out of reach of any fire of this description.

In considering the possible effect of distant fire upon the main caponiers of the German works, there is another element to be taken into consideration. These caponiers have no parapet, or counterguard immediately in front of them. When a hostile battery can be constructed on the prolongation of the ditch that they defend, they have nothing to protect them from that battery but a counterguard, a counterscarp, or a countersloping glacis, some 200 yards distant from them. The comparatively low trajectory of rifled cannon would in this case come into play with good effect. The firing would be accurate, and the projectiles, discharged at low angles of elevation, would be very destructive. The inferior caponiers of the German fortresses, and all those caponiers or galleries for defending the ditches of the advanced forts which face outwards towards the country, along a ditch, whose prolongation can be taken up by the besieger, labour under similar disadvantages; and all the defensible barracks and guard-houses which they have constructed as keeps for their different works, will be more liable to suffer, in the way described, from the effects of distant fire, now that rifled artillery can be brought against them.

Both in the French and in the German systems there will be a liability to an enfilade fire of greater accuracy from longer distances; and the long lines of the latter, as well as the faces and flanks of the bastions of the former, will now be open to this description of attack in some cases in which they were previously secure from it. The ricochet of the elongated projectiles will be less regular, and lower, than that of spherical shot and shell; and it will not continue for any great distance on the line in which the projectile has been fired; but it will still be very formidable; and the projectiles will in many cases do more execution, in consequence of their not rising, after their first meeting with an obstruction, so high in the air.

The parapets of the flanks in the French systems will be more easily ruined by distant fire, and there will be an increased necessity for the use of casemated fire for the defence of the ditches, both on this account, and in consequence of the greater exposure of such flanks to enfilade or reverse fire, in order that, when flank defence is required for the ditch towards the close of a siege, it may still be forthcoming. When these flanks have a tenaille in front of them, they cannot afford low casemated fire for the defence of the ditch; when they are unprotected by a tenaille, and are pierced for guns below the level of the ground, they will then be liable to injury from the besiegers' distant batteries, established on the prolongation of the ditches, in the same manner as the caponiers of the Germans, which have been above referred to.

These are the principal points in which works of fortification, as hitherto constructed, will be affected by the employment of rifled guns. The general operations of a siege will also be materially modified, in consequence of the common use of rifled muskets; and, both in attack and defence, the individual skill and enterprise of the sharpshooter will have an important influence upon the success of the operations, as well as the judgment with which light and heavy guns are brought into play, in proper numbers, for suitable objects, and at the right moment. When these different weapons are thus made available on both sides, the following will be the general course of the operations of a siege:—The besiegers will commence by throwing up distant batteries from the best position that they can select, and as near to the place as their means of concealment and communication will allow, though at far greater distances, in the majority of cases, than have hitherto been prescribed. They will be able to annoy the garrison, and to ruin their works (unless they are constructed on improved methods), from greater distances, and they will more or less subdue and keep under their fire, according to their resources, as compared with those of the place; but they will, nevertheless, have great difficulty in advancing their trenches, and in approaching the fortress, when an ample fire of musketry and light artillery is employed in the defence; and they will be compelled to commence their works at a greater distance from it, to excavate to a greater depth, to resort more to underground operations, and to confine themselves more to the hours of darkness, in their advance, than formerly.

The more distant operations of a siege are those which will thus be principally affected, but the later operations will also be liable to much modification. The common sap, as hitherto practised, will not be available, but will be necessarily superseded, partly by a slower, safer, more certain process of a similar description, and partly by mining operations, and by connecting together the craters formed by the explosion of mines. Mantlets, screens, and pits, will be more in request at most periods of the attack, and more perfect cover, with well built embrasures and blindages, will become more and more necessary in the attack, at the same time that analogous works of a permanent description, with an ample supply of bomb-proof cover, will be wanted in the defence.

So far there will not, perhaps, be very much difference of opinion amongst us. We shall further, most of us, agree, that the great improvements which have lately been made in artillery will require to be opposed by fortifications of a different character from those which have been hitherto employed;

and we shall all concur probably in opinion, as to certain main principles which must be observed in the construction of new fortifications, bearing always in mind that they ought to be built, not only with reference to the present state of artillery and small arms, but also with some margin for the still further power which these weapons may acquire hereafter.

Such principles apply, of course, more or less, to previous, as well as to present and future times, but they have often been too little attended to. They cannot be disregarded in future without more disastrous consequences. Considered with reference to the future, they may be briefly stated as follows:—

1. The masonry of a fortress should be kept, not only out of sight, but also out of the reach, of the besiegers' distant batteries.

2. An ample supply of bomb-proof cover should be provided for men, munitions, and materials of all descriptions.

3. The ramparts should be subject to a minimum of injury from the besiegers' fire, and the parapets should be the least destructible that can be devised at a reasonable expense.

4. The several works and their various parts should be disposed in plan, with a view, first to a distant defence, and afterwards to a step by step defence, of the most prolonged and obstinate description, at the smallest cost, when they are intended to be capable of resisting a regular siege.

5. The flanking defences should not be exposed to destruction from distant artillery placed on the prolongations of the ditches.

6. The means of communication between the main works and the detached works, and between the detached works themselves, should be, as far as possible, secure and secret.

The manner in which these principles may best be carried out, is, however, a subject of great difficulty, and one upon which much difference of opinion is to be expected. I am going now to ask you to listen to the best conclusions that I have as yet been able to arrive at, as to the general form which permanent fortification should in future assume; but I am far from asking you to place any reliance upon these conclusions. On the contrary, I hope you will only receive them as first suggestions; that you will look upon them with great mistrust, and that you will believe in no more of what I advance than may appear, after mature consideration, to be correct, and practically desirable.

Now that long-ranging guns of great accuracy are to be used, it is evident that any works to be constructed for the defence of towns, dockyards, arsenals, or strategical positions, must be extended over a larger area; and now that increased facilities are afforded for bombardment, better means of protection against bombardment are wanted. With regard to towns, the simplest method of solving the difficulty is to leave them as much as possible *un*fortified—a measure which has long been wisely advocated. Where towns, dockyards, or arsenals *must* be defended, the additional extension required for the works becomes a serious element for consideration. It is true that detached forts can support each other, and be supported from the rear, at longer distances; but at the same time their numbers will have to be increased (excepting where the line to be defended approaches to, or is, a straight line), and in many cases the lines of defence in their rear, or the lines connecting them, or the continuous lines in their front, where such are

required, will have to be constructed on a larger scale. It must also be remembered, that the possession of good communications, both between the detached forts themselves and with any supporting works behind them, is almost indispensable to the proper maintenance of such a system of defence. The increase thus required in the area covered by the works, and the necessity which thus exists for long communications, as well as the want of additional casemated fire and bomb-proof cover, and of countermines (as I shall presently shew), have a tendency materially to augment the cost of fortifications. Efficiency must be obtained. Without it all the expense incurred will be little better than thrown away. But economy, combined to the utmost with that efficiency, becomes now a great difficulty, as it is a great necessity, of the problem before us.

Fortification, as will have been already seen, divides itself into plan and profile; and, beginning with the desideratum which is at the head of our list, it will be necessary to consider how the profiles can be arranged, so as to secure the revetment walls from distant fire.

When escarp walls are constructed in the best form, and are backed with earth, and particularly when they are built *en décharge*, or in a series of arches with the piers at right-angles to the front, they are then not so liable to injury as the detached walls before referred to. There is, further, no difficulty in placing the rampart at a greater distance behind the escarp, so that damage to the one will not entail, of necessity, injury to the other, an objection which has constantly been urged against the profiles of the French systems. And, finally, by making the escarp wall, say, ten feet lower, it may be taken altogether out of reach of the distant fire of the besiegers, provided it be covered by a good counterscarp and glacis, not too far removed from it.

But by that means extra expense is incurred; and this, as I have said, must now as far as possible be avoided. When an earthen slope is employed in the place of the counterscarp, that again lays open the escarp, and renders it necessary to sink it to a still greater depth. It has been proposed as we have seen by Carnot, and the German engineers have extensively adopted the suggestion, to employ the counter-sloping glacis; but the escarp wall, or the detached wall, becomes still more exposed, where this plan is carried out, to distant fire; and the advantages of economy, and of facility for sorties, thus obtained, are in this case, to say the least of it, too dearly purchased at the expense of security.

There is another course, however, which is open to us. Instead of substituting an earthen slope for the counterscarp, and trusting to the escarp alone, we might do precisely the reverse. We might, in fact, abolish the escarp, and trust to the counterscarp alone, for a first line of security against assault. It is clear that no direct fire from the front can affect a counterscarp wall; and the ramparts would be secure from any sort of fire from the front, if the escarp were replaced by a mass of earth, sloping gradually from the embrasures to the bottom of the ditch, such as is shown in section in Plate II. fig. 15. The great condition to be fulfilled in carrying out such an arrangement, in a small work, or in a principal line of defence, is the very important one of rendering the counterscarp itself secure against escalade; and this might be done as follows:—

In the same figure the counterscarp wall is, say, 30 feet high, and there

is an earthen slope 10 feet deep, near the foot of it. Eight or ten feet of earth, also, are placed on the top of it, and the counterscarp on the summit is revetted so as to form a smooth surface. There would be required for the descent of this wall ladders upwards of 50 feet long; and it may therefore be considered safe from an attack by escalade, when properly defended, according to the computations that have hitherto been employed, and as shewn by all past experience on the subject.

But it will hardly be necessary to make a counterscarp wall so placed of the height which is here indicated, though its dimensions would vary with circumstances. I shall shew how hopeless any attempt to carry it by a *coup-de-main* would be, after I have described the other works with which it is intended to be connected. I have at all events complied with the first of our desiderata, as far as this revetment wall is concerned; because it will be both out of sight and out of reach of the besiegers' direct fire.

But it must also be remembered, that even a counterscarp wall may have to be protected, in some cases, from reverse fire. Rifled guns will be able to project their missiles altogether over any moderate-sized fortress, and to take the defences on the opposite side of it in reverse; and therefore, any masonry to the rear of which the besiegers can get with their guns, within available range and in suitable positions, will have to be protected from reverse fire by earthen screens, or by judicious dispositions, such as can only be decided on with reference to each particular site.

The masonry and brickwork of a fortress may all be protected from direct fire in a similar manner, by being made to face towards the rear. The required barrack and other accommodation may be obtained, as it has often been obtained in former cases, though in a different manner, beneath the ramparts. For a citadel, for a main line of defence, for detached works, the same principle holds good. When required to be very strong, they may have higher walls and more extensive accommodation; when less important, they may have lower profiles; but they may all be protected in the same manner from assault, by means of one wall placed behind their glacis, and another behind their ramparts.

By this method of construction, the objects referred to in the two first headings on our list are well attained. The walls are hidden effectually from the besieger, and bomb-proof accommodation is afforded in the most economical manner. Instead of having an escarp and counterscarp to resist an assault, a counterscarp only is employed; and that counterscarp may, when it is required to do so, be made at the same time to answer other purposes, of bomb-proof cover, covered communication, entrance to countermines, and flank defence.

Any attempt to construct separate works for buildings and for fortifications must, of course, entail extra expense; but the two are here combined in a form, at once simple, cheap (by comparison), safe from assault, and difficult to injure by distant fire. In this way, all the bomb-proof accommodation that is required, in the main works or in the advanced works, may be first obtained; and a line of bomb-proof barracks, suitably constructed, may then, by the addition of earthwork, be changed into a fortress of a most formidable description. In fact, the necessary buildings are simply placed, in proper form, behind the earthwork which is required for their protection, and behind the counterscarp which is wanted for their defence.

But there are other advantages attaching to such works. If, after much expenditure of ammunition, the besiegers succeed in destroying a portion of the ramparts, the remainder are still defensible. They are naturally divided (by their construction, in longitudinal arches) into defensible parts, analogous to the water-tight compartments of an iron vessel. By the use of musket-proof doors, to close the communication between them, they may be defended step by step. And, even if the enemy obtain possession of them, they are useless to him, because, while presenting a flat glacis of earth towards the front, their masonry is exposed to the rear, and they may be destroyed in a short time by the fire of works behind them.

The ramparts being thus formed in the cheapest and most durable form, and the flat slopes of earth only, which are but little liable to damage, being exposed to artillery fire, we have next to consider how the parapets can be best preserved from injury.

That a very large proportion of casemated fire will be required in future works cannot be doubted; and I have shown, in Plate II. fig. 15, a method in which I think these necessary casemates may be advantageously constructed. I have adopted the general principle of the casemate proposed by General Haxo, which was a brick arch covered with earth; but, where he left exposed masonry at the crown of the arch, I have added a thick iron plate, the better to secure it from destruction.

One of the great fortification problems of the present day, is, how such iron plates can best be applied to parapets, now that they have been found to be so powerful in resisting the effects of shot on the sides of vessels of war. Such plates, if placed vertically, and liable to be struck by shot at right-angles to the planes of their surfaces, cannot be expected, unless they are of considerable thickness, to resist repeated blows, delivered, perhaps, on nearly the same spot; and any iron construction of this nature that will do so, is exceedingly expensive; besides which, it would be impossible to repair a parapet of such material under fire, and difficult to replace it when damaged, by explosion or other means, within a limited time.

But, if 4-inch or 5-inch plates be placed in a slanting position, as shown in the figure, they will be less easy to strike, and very difficult to injure. Such plates ought to be bedded in timber, in order to secure them conveniently in their places, as well as (in this position) for the sake of elasticity, to prevent injury to the masonry below them when they are struck; and, in applying them, the size of the embrasure should be reduced as much as possible, though we cannot suppose that that will altogether prevent the enemy's shot from entering it.

The covering mass of earth on the top of the casemate affords an open parapet, which may be used for the service of infantry when required, and for that of light artillery when there is sufficient space.

Our fourth heading has reference to the principles by which we must be guided in determining the plans of future works of fortification.

The principle has been very plainly stated by Choumara, and has been partly acted upon in different countries, in the outworks and the advanced works of both the French and German systems, as I have already stated, that the besieger ought to be delayed by a series of obstacles successively opposed to him. If the besieger is able to undertake at the same time the operations required for breaching the revetment walls, and passing

the ditches of several works, or of several parts of a fortress, then the time occupied in such operations is no longer than if he were compelled to ruin only one wall, and to cross only one ditch; but if, on the other hand, he is unable to carry on more than one of these operations at one time, and is obliged to undertake them one after another, then the time occupied by him is increased in proportion to the number of works opposed to him. If he were compelled to carry on a regular attack against two detached forts, one after another, he would thus, if these were well constructed and properly supported, be detained before them, other things being equal, twice as long as before a continuous line of ramparts, or two detached forts in one line. A step-by-step defence, as it has been called, conducted in this manner, has such obvious advantages, that it is only necessary to state the nature of it, in order to show how desirable it will be to adopt it as much as we conveniently can, and as far as it may be required in particular cases.

In applying this principle, in conjunction with the profiles which I have put forward, to the construction of a fortress, it would be desirable, in some cases, to employ a comparatively small (perhaps an existing) fortress as a citadel, or a continuous interior line of defence as a nucleus, and to surround these by advanced forts, constructed at various distances, in varying numbers, with different dimensions, and in different forms, according to the nature of the ground, the estimated number and character of the garrison, and the means available, or calculated upon, for the defence.

The forts shown in the diagram are simple barracks, of which the upper story is fitted for guns, covered with earth towards the country, according to the section in Plate II. fig. 15. In front of them, at the foot of the slope of earth which forms their rampart, are one or more counterscarps, connected with countermines. The besieger would be compelled to direct successive attacks against each counterscarp, and against each line of forts. He would be obliged to resort to mining before each countermined counterscarp; and, if he succeeded in reaching, and blowing in, the main counterscarp, he would still have great difficulty in getting possession of the works behind it, the approaches to which would be flanked by casemated caponiers of a most formidable description, in the manner indicated in the diagram. When the lines to be defended are not straight, as is most frequently the case, the flanking caponiers should be placed at their angles rather than in the centre of them, in order that a duplicate defence might be ensured to every part, not necessarily for simultaneous employment, but that, if one redoubt should be destroyed, the flank defence might be taken up by the flanks on each side of it, and might still remain perfect. The parapets and ramparts of these caponiers are somewhat similar to those of the other works; and they are provided with internal traverses to protect the gun-casemates from reverse fire, to form communications to the front, and to act as interior defences against sudden attacks.

The intervals between advanced forts would be advantageously occupied by rifle pits, or earthen batteries, to be thrown up or employed as required; those between forts composing a main line of defence, where such is employed, by continuous ramparts.

In the defence of long straight lines, or of other extended positions, the relative advantages of detached works, and of continuous lines, have been

much discussed. I cannot here enter into all the arguments on either side of the question; but I would point out that the advantages of detached forts, and those of continuous lines, may be most conveniently combined by the method that I have described. A continuous counterscarp constructed in front of detached forts of this description, as shown in Plate IV. fig. 15, would be impassable to a besieger, unless after a regular siege. The detached works behind it would oblige the besieger to make his approaches on particular points which could be purposely prepared for his reception. Each would present, in itself, a maximum of offensive power and defensive resistance at a minimum of cost. This arrangement would have all the advantage of detached forts; in presenting points of security along the line occupied, and a means of safety for the remainder of that line after one point of it was forced; in being much more economical than continuous ramparts with escarps and counterscarps; and in capability of defence by a small garrison: it would also possess the advantages of a continuous line—in being better prepared for the reception of, and for giving useful employment to, increased forces; in affording perfect communication along the whole line, and in being secure at all points from any sudden irruption of the enemy under cover of darkness, for the purpose of passing the line, or for the attack of any intermediate works of a temporary character thrown up between the permanent forts.

Under a fifth heading, I have stated that the flanking defences must not be exposed to destruction by distant artillery placed on the prolongations of the ditches. I may add, that they should not be open to enfilade, or to interference in any way, from the enemy's fire.

I have already said a few words in reference to this subject, as applied to some existing works and systems. In the bastion system, as we have seen, either the flanks are liable to be fired at on the prolongations of the ditches when they are unprotected by the tenaille, or else they are masked by the tenaille, and prevented from defending the ditch by casemated fire. The parapets of the flanks are ruined by the enemy's artillery before they are required for use; and the tenaille itself is liable to be ruined in the same manner as the flank.

In the German fortresses, also, you will remember, that the caponiers, on which alone the main ditch depends for defence, though strongly and expensively constructed, are similarly exposed to injury in all cases in which the prolongations of the ditches can be taken up; and that the same may be said of the flanking defences of the smaller works.

These defects may be partly remedied by the employment of flanks firing inwards, instead of those firing outwards towards the country. In most advanced works, and in all works having salients projecting towards the country, a flanking fire from the counterscarp, or from a bastionet, or caponier, at the salient angle, would obviate the objection. The Germans have adopted this measure in some cases, and it has also been adopted in some of the forts in course of construction in this country, as I shall presently explain. To illustrate further what I mean by an inward, as opposed to an outward, flank defence, I would refer to a bastioned front. If this were reversed, or turned inside out, as has been done in the case of the main counterscarps at fig. 15 of Plate IV.—if, in fact, the bastion form of escarp were thus adopted for a counterscarp, then the flanks would direct

their fire inwards in place of outwards; and it is probable that this reversal of the bastion trace may be found hereafter to be exceedingly useful. A flanking fire of musketry and artillery, in the nature of a reverse fire, from a hollow counterscarp, will be a very desirable means to adopt, in future, as a protection against assault; and it is probable that it will be much employed, as being economical, and secure from interruption from the besieger's weapons.

Such a means of flank defence cannot always be entirely depended upon, when the chance of a prolonged siege has to be provided against, because, as the besieger approaches the place in the course of his operations, he arrives, at length, by means of his mines at the back of the counterscarp, and blows it in; and, when this is done, an independent flanking fire, connected with the body of the place, is needed to check his further operations. To supply such an independent fire, and to give support between one work and another, I propose to employ the casemated caponiers, or redoubts, already referred to, which should expose nothing but earth and iron to the besieger's fire in all cases in which they would be liable to be cannonaded. Flanking works of this description are shown in plan and profile in the diagrams. They could hardly be destroyed, except by the besieger's mines, after the blowing in of the counterscarp; and this would, if properly opposed, be a tedious and difficult operation. They would afford mutual protection to each other in an efficient manner, and they would prevent all approach up the glacis-rampart, as it may be termed, until their destruction was effected.

My last heading refers to the question of communications.

I have observed that the use of long-range weapons will lead to the occupation of extended areas, and that detached forts in advanced positions, which have been already extensively employed, by the French as well as the Germans, in connection with recent fortresses, and which are coming into use also in this country, have now become still more necessary,—to save expense, to delay the progress of the besiegers, and to make small garrisons available against large numbers. But good means of communication are all-important to any system of defence by detached works. The more these detached forts are treated as isolated works, to be occupied and defended by a limited garrison, the weaker they become; and the more the resources of the place can be concentrated at the proper time, for the support of any advanced fort or forts forming the immediate object of attack, the stronger is the whole system of defence. The French have considered their detached forts more in the light of isolated forts; they have prepared them more with reference to their separate defence; and they have made them, if not equally strong, yet more complete on all sides. The Germans, with all their mistakes of construction, have looked upon these works in a different and apparently in a more proper light. They have been more careful in providing for their support by the fire of other works, and in contriving that the different works of a position should mutually contribute to the general defence; and they have attempted to render their detached forts sufficiently secure at the gorge, at the same time that they may be more or less easily destroyed after capture. They have also attended more than the French, in some cases, to the supply of underground, or other suitable communications. But much more will have

to be effected in this way in future, in order that troops and stores may be advanced or withdrawn as required, to and from the different works, in security, and unknown to the enemy.

The so-called covered way by which systems of fortification have generally been surrounded, might more properly be termed an uncovered way, from its exposure to vertical and enfilade fire. From the latter, its irregular form and numerous traverses afford only partial relief; and it has, in fact, in consequence of its acknowledged defects, been in many cases discontinued altogether.

To fulfil the intended functions of such a work—of affording a musketry fire to the front, of supplying a covered communication round the outside of the main works on the further side of the ditch, and of providing the besieged with a secure retreat from the front, for sharpshooters, for troops returning from a sortie, or for detachments in advanced positions,—other means will now be required. For musketry fire, chains of rifle pits, in suitable positions, will be found in most cases more suitable than a continuous parapet. For the other purposes referred to, a really covered way might be employed, consisting simply of an arched gallery in masonry, covered with earth towards the front, and open towards the rear. It might be used according to circumstances, with parapets, or rifle pits, above it, or in front of it, or behind it. It would be useful, not only for purposes of communication round the exterior of any particular works, but also as a sort of connecting counterscarp and covered communication between detached works. Its dimensions would of course be regulated by circumstances, and it might vary from 10 to 30 feet in height. The besieger could not destroy it; he could not pass it; and he might be harassed by riflemen, possessed of a secure retreat to it, in a manner that would be most advantageous to the defence. It would afford a good point of commencement for any countermines to be employed for delaying the progress of the besieger toward the advanced works in its rear, and, when connected with such countermines, it could only be approached by the besieger by the slow process of mining, commenced at a greater or less distance in front of it, according to the extent or the reputed disposition of the countermines. Such a work would, in fact, become the front counterscarp shown in fig. 15, Plates II. IV.

Any attempt at a *coup-de-main* upon works such as I have been describing, would be utterly hopeless if the defenders were at their posts. It will be readily seen, by referring to one of the detached forts behind the main counterscarp at Pl. IV. fig. 15, and comparing it with the profile in fig. 15 of Pl. II., that if the besiegers did succeed in descending the main counterscarp, and getting into what may be called the ditch, they would then be exposed, to the full fire of the ramparts in their front, to that of the flanks of the counterscarp in their rear, and to that of the casemated flanking works on both sides of them. Situated between these fires they would be equally unable, to ascend the sloping rampart, to penetrate into the counterscarp wall, or to make their retreat; and they would be helplessly shot down, or forced to surrender. They would also be unable to advance, except by mining, after having blown in a portion of the counterscarp, until they had got possession of the flanks of that work, and had silenced the fire of the casemated flanks on both sides of them, and that of

the faces in front of them. If they succeeded in descending the interior counterscarp, and in afterwards mounting to the top of the rampart, they would then be under the fire of the flanking works of the forts on either side of them, and also of the keep of the work itself, and they would arrive at another high wall, down which they would have next to descend, without any prospect of shelter at the bottom of it; or, if they were to make their way round to the rear, they would there find the rear counterscarp and the interior wall of the keep opposed to them.

We have now more than arrived at the end of our time; but I would say one or two words by way of summary before we part. I have purposely omitted details as far as I could, in order that we might take a comprehensive view of the question; and I will now endeavour to generalise still further.

For more than 5000 years, as we have seen, in the history of our race, there was no great difficulty about fortification. It was only necessary to build a wall of sufficient height and strength, and to excavate a ditch in front of it, to keep the besiegers' battering-rams away from it for as long a time as possible, in order to place a garrison in a tolerably secure position.

This state of things endured until gunpowder came into use. Since that time there has been, for the last 400 years, a continual hide-and-seek struggle between the attack and the defence; the engineer of the defence endeavouring to hide his walls, and to shelter their defenders from the artillery of the attack; the engineer of the attack taking advantage of every portion of ground less well defended than the remainder, for advancing his works, of every opening or opportunity for destroying his enemy's escarp walls, and of every unsheltered portion of the works for the operation of that description of fire best adapted for harassing the troops and the artillery of the defence. Up to the present time the protecting wall has contrived, through all its difficulties, to keep its face towards the enemy's fire, either in the shape of a revetment, or a detached wall; but it has always suffered more or less in the attempt, notwithstanding the ingenuity that has been displayed for its concealment and protection, and its destruction has only been a work of hours, when once the assailants have been able to open their batteries against it, or to approach it with their mines.

A new era in fortification is now dawning upon us; and I submit to you, that this protecting wall must not be ashamed to turn its back upon the improved weapons with which it is liable in future to be assailed, in order that it may become, at once more formidable to its assailants and more useful to its defenders. By forming part of a system of bomb-proof accommodation, and by hiding itself behind ramparts and glacis, it will be indestructible by artillery; and, being connected with a system of countermines, it will be protected for a lengthened period from the enemy's mines. The besieger will thus be prevented, at comparatively moderate cost, from successfully employing the very powerful means of distant destruction which he has acquired; he will be effectually checked in his advance; and he will be reduced, in his attack, to the slowest rate of progress that can be imposed upon him.

The operations before Sebastopol, which are still so vividly before our minds, have been sent to us as a sort of first lesson of what we are to

expect from the use of superior weapons. The Russian riflemen were there most effective, and prevented the allied troops from showing themselves out of their trenches at the later periods of the attack. Artillery was employed from great distances, and, though not with anything like the accuracy that may in future be expected from it, yet with very destructive effects. The daily losses on both sides were enormous. In consequence of the difficulties of the soil, and the position and resources of the enemy, the English trenches never advanced to within 200 yards of the Russian works; and British troops never succeeded in an assault upon those works, in spite of their very inferior construction. The French experienced by far the greater part of their losses, and all their difficulties, in the course of their gradual advance. The Russians opposed that gradual advance, by holding with great obstinacy all the ground that they could possibly retain in front of their naturally strong, though weakly fortified, position,—by seizing all the advantageous sites of that position,—by employing all the men they could muster, and all the resources they could collect, to check the formation of the besieger's trenches. They suffered so very severely themselves, because they had not the advantage of a properly prepared enceinte, with bomb-proof cover, or well-constructed advanced works, with good shelter. Their troops were thus exposed to fearful destruction from the allied fire, and were unable to be maintained in sufficient numbers at points where they were most required. They finally lost the key of their position, because it had not been made secure against a *coup-de-main*, and because it had not been furnished with the amount of bomb-proof cover that was requisite to enable them to retain a sufficient garrison in it under the heat of the allied fire.

They also harassed the allies by means of sorties, and compelled them to be perpetually prepared to meet those sorties with troops that had almost more of labour and watching to undergo than nature could endure.

It has often been urged, that these proceedings cannot be taken as a guide to the ordinary operations of attack and defence, because the Russians possessed more extensive means, in men, munitions, and materials, than would be at the disposal of the commander of a regular fortress; and because they had the unusual advantage of free communication with the exterior. It is quite true that they were thus enabled to withdraw their worn out troops, and their sick and wounded, and to supply fresh ones in their places, as well as to procure supplies of stores and munitions; and that they obtained most important advantages in these respects. But even these facilities did not compensate to them for the imperfect condition of the works on which they had principally to base their operations. Their reinforcements of men were only brought, after great fatigue, after terrible privations, and after long marches, over desolate regions, for the most part to be miserably sacrificed to a want of proper accommodation. Such stores and munitions as they could thus add to their stock could not be employed by any means to the best advantage; and it is certain that, if they had been provided with suitable permanent works, they would, with far less advantage of communication with the exterior, have been able to prevent the allied forces from obtaining possession of the key of their position for a much longer period.

From this point of view, I look upon those operations as affording lessons

of a most important character. They seem, in fact, to be a link, connecting the operations of the past with those of the future. They mark the commencement of a new transition style, so to speak, in defence. They indicate to us, once more, the disadvantages of former systems of fortification, in which small garrisons have been confined in limited areas with inferior means of shelter, and wretched opportunities, to what they might have had, for obstinate defence. They add force to the old French proverb, *petite place, mauvaise place.* They point to the advantages that may be acquired from the use of new weapons in enlarged systems of fortification, and to the impossibility, under ordinary circumstances, of successful defensive operations in future, unless such enlarged systems of fortification be adopted.

I shall not attempt now to apply the principles which I have advocated to the immediate question of our own defensive works; but I may observe, that there are two very important points, amongst many others, which ought to receive attention, in order that economy and efficiency may be duly combined in their construction. In the first place, not only the ramparts, but also the barracks, and other buildings of an extensive nature which may be required in future for military purposes in this country, should be constructed with reference to a well-considered general system of defence, though it may often not be possible, of course, to make them directly to contribute to that system of defence.

In the second place, advantages of position become the more important, now that musketry fire is effective for upwards of half a mile, and now that artillery have acquired the power of ranging for five miles, and of striking a target 6 feet square at a distance of two miles. There are cases, however, not unfrequently, in which the occupation of disadvantageous sites is unavoidable; and it becomes then necessary to apply with the greater circumspection the best remedies that the site affords.

I may also point out very briefly the leading principles on which fortifications are being designed for the defence of this country. Besides the works, intended to protect our dockyards and arsenals from an attack by sea, which are to consist principally of sea forts and land batteries, with the occasional assistance of floating batteries and booms, it is proposed to surround these vital points by detached forts, such as are shown in Pl. IV. fig. 14, to secure them against bombardment, up to a distance of 8,000 yards, wherever, not being screened by rising ground, they are exposed at that distance to such a mode of attack.

The detached forts are to be placed at central distances of a mile, or less, from each other, according to the nature of the ground to be occupied, with reference mainly to the commands of the sites which it presents for these forts, and to their capabilities in sweeping with their fire the spaces between them. Their faces, not supplied with casemates in the first instance, will, of course, be so laid out as to give the best direction to the guns on the ramparts. Their flanks are to be provided with gun casemates, and are to be employed, not for defending the ditches, (excepting when they may be available for raking any connecting lines between the forts which may hereafter be constructed), but for affording a cross fire upon the intermediate spaces, and for purposes of mutual defence and support between one fort and another. Their ditches are to be defended

Fig. 2.
Profiles of Ancient Fortifications.

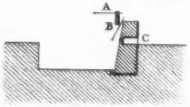

Fig. 1.

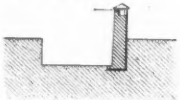

Fig. 3.
Profile of the Circular System of Albert Dürer, A.D. 1527.

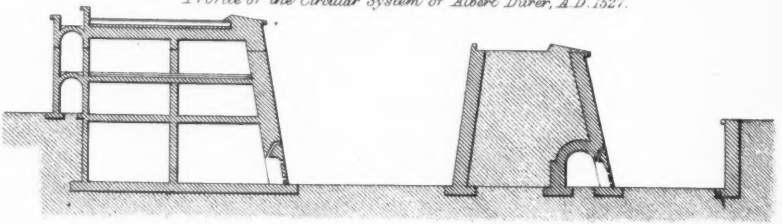

Fig. 4.
Profile at Berwick upon Tweed.
Section on A.B. Fig. 2. Pl. 3. close of the 16th Cent.

Fig. 5. *Profile of Modern System; Section on A.B. Fig. 7. Pl. 3. A.D. 1764.*

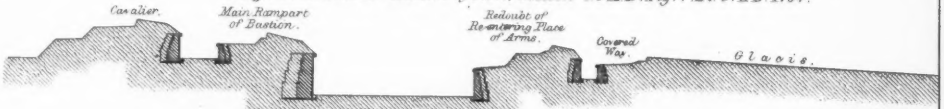

Fig. 6. *Profile of Montalembert's Circular System, A.D. 1793.*

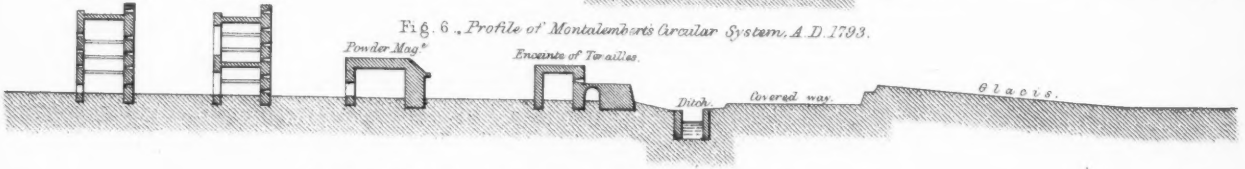

Fig. 7. *Profiles proposed by Carnot, A.D. 1810. for his Third or Tenaille System.*

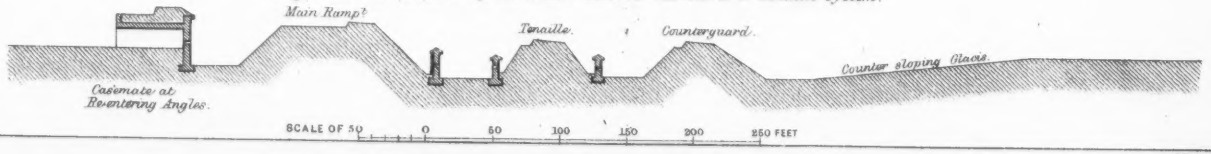

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Fig. 8. *Profile of Fort Alexander, Coblentz. Section on A.B. Fig. 9. Pl. 3. 19th Cent.*

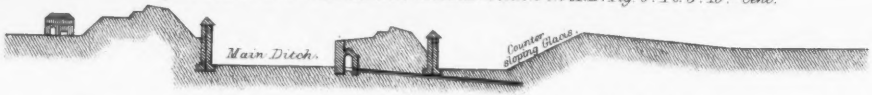
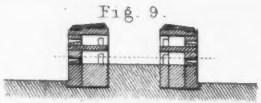


Fig. 9.



Section on C.D. Fig. 9. Pl. 3. of Central Caponier at Fort Alexander, Coblentz.

Fig. 11.

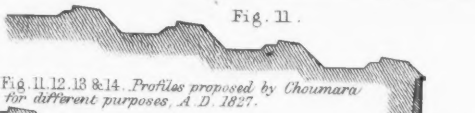


Fig. 11. 12. 13 & 14. *Profiles proposed by Choumara for different purposes. A.D. 1827.*

Fig. 12.

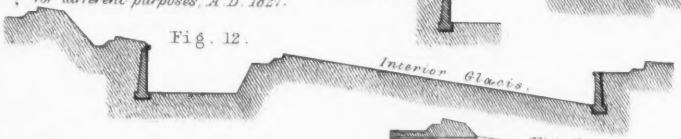


Fig. 13.

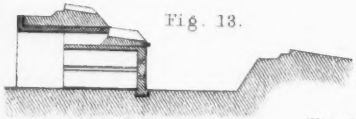


Fig. 14.

Thick Iron Plate.

Face. Casemated Flank.

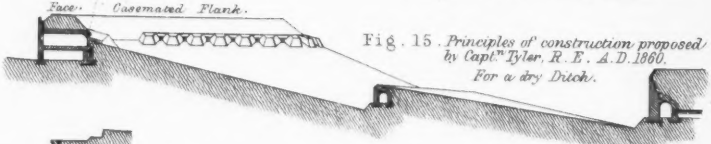


Fig. 15. *Principles of construction proposed by Capt.n Tyler. R.E. A.D. 1860. For a dry Ditch.*

Fig. 10. *Profile of one of the detached Forts at Cologne. Section on A.B. Fig. 12. Pl. 4. 19th Cent.*

Fig. 16. *Profile shewing principles of construction on which detached Forts have been designed for Great Britain. A.D. 1860.*

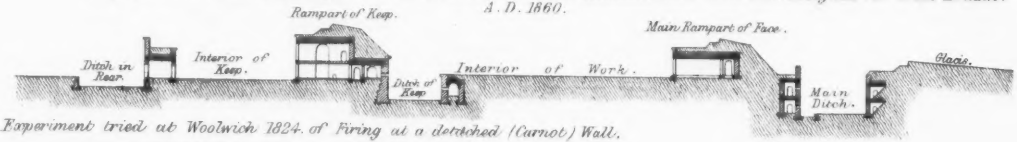


Fig. 17. *Experiment tried at Woolwich 1824. of Firing at a detached (Carnot) Wall.*

Scale.

50 0 50 100 150 200 FEET

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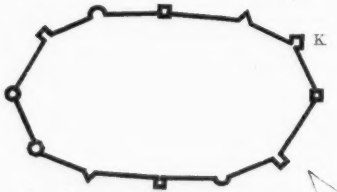
Fig. 1.



Plan of Ancient Fortification, with Towers of various forms.

Fig. 2.

At Berwick, upon Tweed; Italian System, close of 16th Cent.

Fig. 3.

Pagan's System, A.D. 1645.

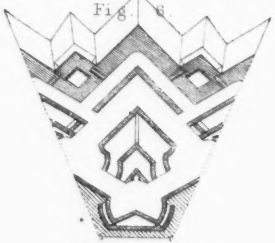
Fig. 4.

1st System of Vauban, A.D. 1680. adapted for a wet Ditch.

Fig. 5.

3d System of Vauban, A.D. 1698.

Fig. 6.



Coehorns 3rd System, A.D. 1742.

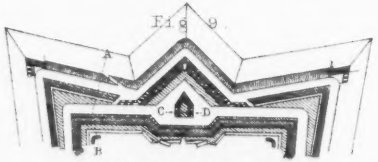
Fig. 7.

Modern System, latter part of 18th Cent.

Fig. 8.

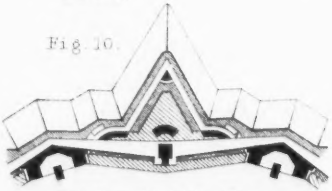
Bousmard's System, A.D. 1799.

Fig. 9.



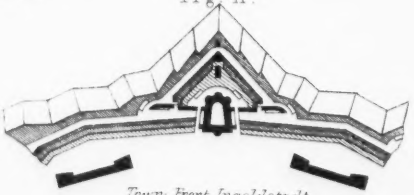
Fort Alexander, Coblentz, 19th Cent.

Fig. 10.



Fort Vimar, Citadel of Posen, 19th Cent.

Fig. 11.



Town Front, Ingoldstadt, 19th Cent.

Scale

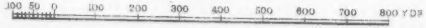


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Fig. 14. *Plan illustrating principles of detached Forts, intended to be constructed in Great Britain.*

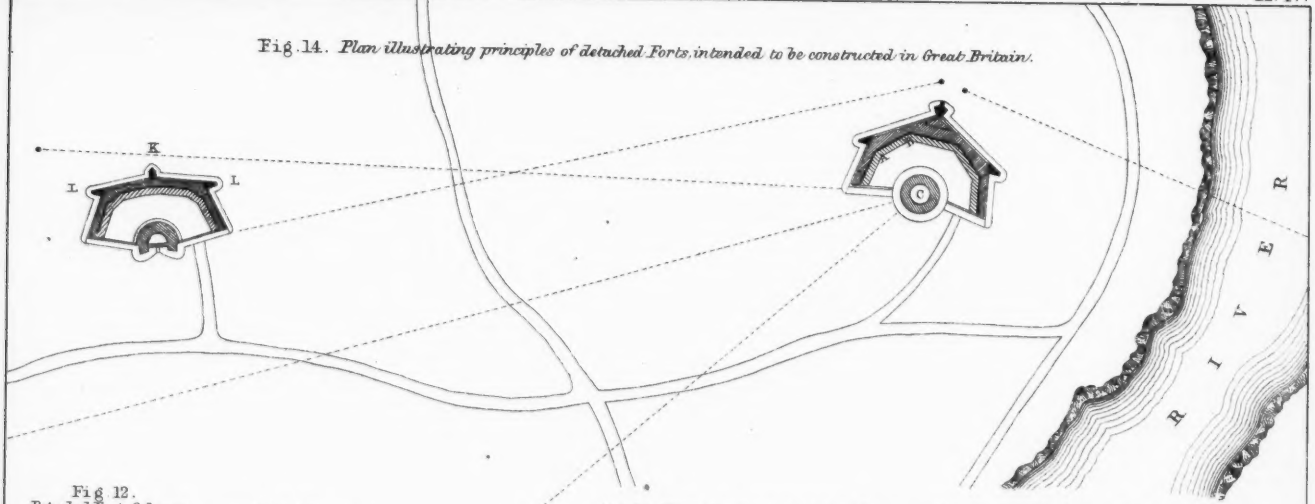
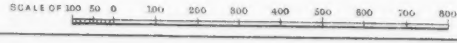


Fig 12.
Detached Fort, Cologne; Present Cent^e

Fig 13.
German detached Fort.

Fig. 15. *Plan shewing principles of construction, for detached Forts, by Capt^n Tyler, R.E*



J.R Jobbins

by caponiers, one (K, in the figure) at the salient angle, firing right and left along those in front, and two (L, L, in the figure) at the extremities of the faces, firing inwards along those of the flanks. These latter, forming wings, as it were, to the works, are new in principle, and have the merit of being secure from the enemy's missiles, by firing towards the interior of the position. A keep is constructed in the rear of each work, to enable it to be held in security by a small number of men, and to be safe in the event of the exterior work being itself penetrated by the enemy by a *coup-de-main*. The circular keep C, shown on the right of the figure, is flanked by small masonry caponiers constructed round its circumference, and is not in the most favourable form in one respect,—that a great number of flanks (as many as sixteen) require to be manned for its complete defence, with a very limited range for the weapons employed in them.

Looking to the (specimen) profile of those works in figure 16, Pl. II., it will be observed, that bomb-proof buildings are to be constructed under the ramparts of the keeps, as well as under the main ramparts, and that the ditches in front of both are revetted in masonry, the escarps in each case being kept low, that they may be shielded from the effects of distant fire, and the escarp of the main ditch being surmounted by a parapet, to protect the *chemin-des-rondes*, from which a musketry fire may be directed upon the covered way in front. This small parapet affords additional height to the escarp as long as it is intact, but is liable to be destroyed from a distance by the guns of the enemy; and the besiegers, arriving at this point, would find shelter on the *chemin-des-rondes* from the direct fire of the work itself, and could only be annoyed, either by missiles projected over its ramparts, or by the fire of neighbouring works. The keep is defended in the rear by a wall considerably lower than the rampart in its front, and connected, like that rampart, with bomb-proof buildings.

Rifled artillery is not yet old enough to have produced a perceptible influence upon actual constructions in fortification in any country; but we are fortunate in this country in one respect,—that we are aware of these important improvements in musketry and artillery, whilst a large proportion of the works necessary for our defence are still unconstructed. British weapons are at the present time superior to those of any other nation, and I trust that British fortifications will prove to be equally pre-eminent in adaptation to the particular objects for which they are required. If I should be the means of contributing in any degree, however small, towards such a result, by exciting additional attention to, or by inducing discussion on, the subject, then I shall not regret having given you the trouble of listening to so much that possesses more, I fear, of technical, than of popular, interest.

N.B. The accompanying plates, referred to in the above lecture, are intended to form, of themselves, a brief sketch of the history of fortification, and to illustrate, as far as the space permits, the different ideas that have been put forward in that branch of science from time to time. The plans and profiles have all been reduced, respectively, to the same scale; and have thus been made to afford, at a glance, a means of comparison, with regard to their relative dimensions.

Wednesday, May 30th, 1860.

Captain E. G. FISHBOURNE, R.N., C.B., in the Chair.

AN IMPROVED SYSTEM OF SHIP-BUILDING, AND ITS GENERAL ADVANTAGES IN POINT OF STRENGTH, CAPACITY, AND SPEED.

By GEORGE R. TOVELL.

STIMULATED by the recent statements publicly put forth by the new Society of Naval Architecture, and at the request of several members of the Royal United Service Institution, I am led to embrace the opportunity, now so kindly afforded me, to contribute my mite of practical experience to the accumulating fund of information, which will doubtless be found ample to effect the object which at this time is more particularly engaging the attention of all maritime nations; viz., the perfecting, so far as human ingenuity can perfect, that which is a staple of our own country,—the ship and her equipments.

But, Mr. Chairman, before venturing to do so in the presence of so much practical knowledge of the subject (which I trust I know how to appreciate), blended, as it is, with intelligence of the highest order, I do most respectfully ask from you, Sir, and from this assembly of gentlemen, all the indulgence you can award to an old man, who for the first time in his life ventures to speak before a public assembly.

As I am a perfect stranger to most of the gentlemen composing this meeting, whom, with yourself, I have now the honour of addressing, will you, sir, be pleased to permit me, for general information, to state that I have been intimately connected with ships, and what relates to them, for at least forty years, during which time I have had an opportunity of gaining some little experience, as a shipmaster, shipowner, and ship-insurer or underwriter. Possessing, naturally, I suppose, a disposition to try and improve the form of ships, I have been led to alter materially many of the old build, and to design some new ones, long before I thought of reducing my practice to the system which I am about to bring to your notice.

I have been a close observer of the qualities of different ships in a seaway, when under sail, and at anchor, which no doubt has enabled me to effect some advantages in designing, rigging, and sailing my own ships, and which has led me often to disregard adverse opinions.

I am led, sir, to make these preliminary remarks, from reading some, of rather a sweeping character, made by one of the speakers at the recent meeting of naval architects, as to the very little good, in his estimation, that had arisen from patented improvements in shipbuilding, assigning as the cause the ignorance of most of the patentees; now it is not impossible

that, with equal applicability, this might be said of some of the objectors. But whilst I do hope to be free, if not from the full force, yet in some measure from this censure on patentees, I wish it to be clearly understood that I make no pretensions to the purely scientific attainments which most likely fell to the lot of that speaker; yet I do not believe I should be, in the formation of ships, much a gainer by exchanging my practical knowledge, small though it may be, for his scientific attainments, for it must be admitted that abundant opportunity has been afforded to scientific gentlemen to produce ships, yet very many of their productions are now found not to answer the purposes for which they were designed.

Simply aided by a little practical knowledge of what the sea likes, if I may be allowed the expression, and an average share of common sense, I have ventured to place ships, of the form I am now about to advocate, upon her bosom.

And now to my task. First, then, what I have aimed at is simply this: to get a strong, well-conditioned, seaworthy ship, possessing capacity enough for cargo to remunerate her owners, and speed sufficient successfully to compete with the navies of other nations; and I may also add, to escape an enemy, even should that be a deadly lee-shore.

Knowing well, Sir, that speed without capacity could not be generally useful, and that these combined, without strength, were worse than useless, I set myself to devise a form in which all three should be found in the largest degree compatible with the other essential qualities of a well-conditioned ship.

After no inconsiderable thought given to the matter, I was led to the adoption of the circle (or rather segments of it), seeing that it possessed two of the three things I was seeking for, viz., strength and capacity.

My next business was to determine how they could be brought into the general construction, so as to secure speed with free or adverse winds, good steering, and other qualities.

To help me in my decision in this, I sought for that in nature which would guide me, as so to arrange circular frames as to get speed with space. To this end I examined fish, and was led to say to myself, "they can pass swiftly through the water, but they have not capacity sufficient for my purpose—no room abaft; nor could vessels of their form carry sail."

I then turned my attention to the water-fowl, and in them discerned capacity and power, but no speed like the fish, which was what I wished, if possible, to attain.

Now from my youth up I have believed, that the Great Designer was the only unerring architect; and was on that account unwilling to seek instruction in any other school—so I at last determined to avail myself of the salmon's head and shoulders for the fore-body, and the after-body of the swan for that of my intended ship, believing that, by their judicious combination, I should get capacity, power, and speed, with wind free; at once foreseeing that, with such a form, weathering and excellent steering qualities were placed within my reach, by the adjustment of dead-wood and keel. Here I cannot refrain from availing myself of a very trite observation of Mr. Scott Russell's, "that a good ship should have the easiest form to go a-head, and the most difficult to get to leeward." I hope I shall be enabled to convince this meeting that I have succeeded in obtain-

ing these desirable qualities, in no small degree, by a process as simple as it is truthful, and which I now proceed to explain.

The length of the deck, depth of hold, length of keel, being decided on (having regard to the particular service the vessel is intended for), the line A, B (fig. 1) is to be drawn to a given scale; this represents the deck line. Having added to the depth of the hold the thickness of the floor timbers, inside plankings, and keel, at this distance from and parallel to the line A, B, draw the line C, D, to represent the lower line of the keel, upon which set off the length of the keel, making allowance for the intended rake of the stem and stern-post. Then draw the lines H, E, forward, and F, G, aft; these represent the outlines of the stem and stern-post. On these lines mark the points H, I, for the fore and after ends of the load water-line, and at the place of greatest breadth (which may be at any distance from the stem) mark a point K, showing the upper part of the keel; then with the proper radius draw an arc, cutting the three points H, K, I. This is to form the top of a solid frame-work connecting the stem and stern-post by curved dead wood, upon which the frames forming the hull or body of the ship are to be placed. From the point H, a line is now to be drawn to a point L; by this line the curves of the timbers at different points are regulated. The particular angle or curve to which this line is drawn is entirely arbitrary, and dependent on the judgment of the designer of the intended vessel's form, and the particular service she is required for, as we shall show after describing its use. If it be required to know the form of the timber or frame of the ship at the point K, draw a perpendicular line from thence to the line H, L; with the radius M, K, draw the arc N, K, O, carrying it up to the deck line, which will be the outside form of the timber or frame of the ship at the point K; and this operation is to be repeated to determine the form of every rib throughout the vessel's length, in all cases taking the radii from the line H, L, to the curve formed from the points of the load water-line H, I. It will be observed, that in proportion as the line H, L, rises above or falls below the deck line at any part of the hull the circles are of greater or less diameter, and consequently the after part is broad as compared with the fore body, where the line H, L, dips considerably below the deck line. For this part of the hull, where the bow draws in and becomes fine, the semi-circles formed by radii obtained as before described are too shallow to reach the sheer line, they must therefore be carried up by perpendicular lines to the line A, B.

From what has been stated with regard to the line H, L, and the method of regulating by it the entire form of the intended vessel, it will be evident that it is only necessary to vary the inclination or curve of this line to obtain vessels of any form or capacity that may be required. Thus, if it is desired that the ship should be fuller at the bows, the line H, L, must be carried upward, as shown by the dotted line *a*, *b*; if, on the contrary, a finer bow is wanted, the line H, L, is to be carried lower, as at *c*, *d*; the after part of the body or hull being made finer or fuller, as desired, by varying the line H, L, in the manner just described, still retaining the form of hull peculiar to this invention. Fig. 2 represents the half-breadth or deck plan of a vessel, where the breadth and depth of the vessel are alike, the semi-circles in fig. 1 giving the outline of the one-half of the deck of the intended vessel. Fig. 3 is the "sheer plan" or longitudinal

FIG.

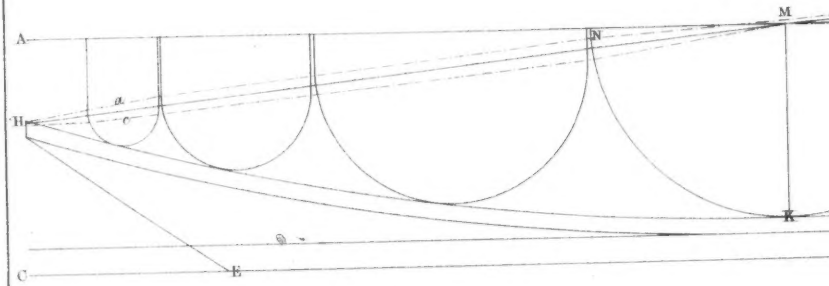
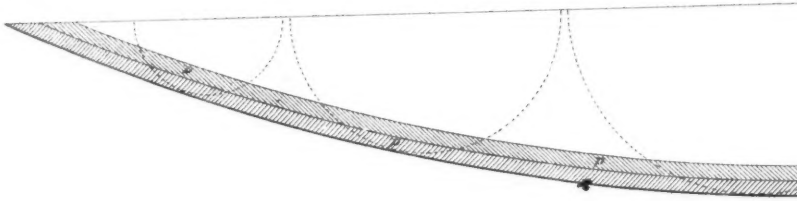


FIG.



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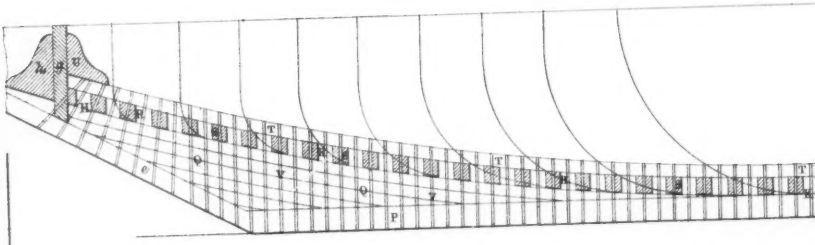
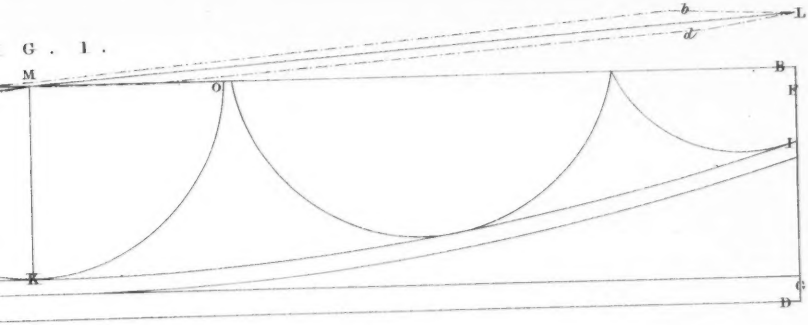


FIG.

G . 1 .



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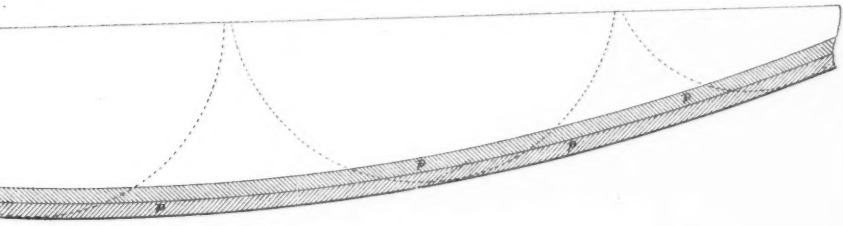
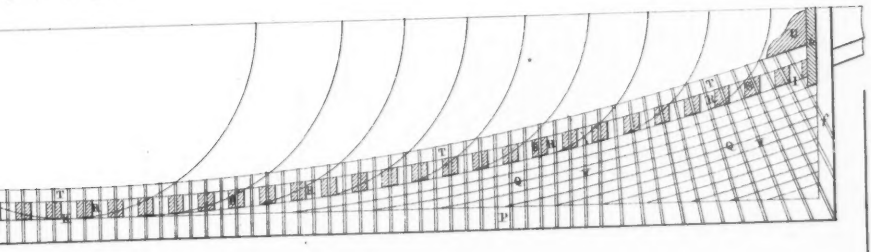


I G . 3 .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section of a vessel drawn to the same scale as fig. 2. P is the keel upon which the curved timbers Q, Q, Q, are built, forming the arc H, K, I, (fig. 1.) The stem and stern-post *e*, *f*, being secured to the timbers Q, Q, Q, the frames R, R, of the hull are then set up; between each frame a solid chock S, S, is fitted, connecting or supporting each and all the frames from stem to stern. Over these frames, thus firmly chocked, the kelson T is wrought, terminating with a strong wood knee U, U, fore and aft. The whole of these timbers are firmly secured together by bolts V, V, passing through them, and secured to the under side of the keel, uniting also the stem and stern-post, and rendering the frame-work and lower part of the ship one solid mass of timber. The tendency which a ship of the ordinary construction has for "hogging" or arching in the centre shows itself from the moment of launching, and this is increased to a very injurious extent when the vessel is pitching in a troubled sea: the wave as it rolls under the vessel lifting it in the centre, while the ends are comparatively without support; this has the effect of straining and loosening every part of the ship's framing. Now, the inverted arch form given to the dead-wood of the vessels herein described, and the manner in which the entire frame-work and keel are bound together, will obviate this evil, or at least tend to very considerably mitigate it. A short stem, *g*, is fitted upon the main stem, to which is secured the fore knee U; it also receives the fore end of the top planking, and gives additional strength to the fore body beyond the stem *g*, which is further secured to the main stem by a knee *h;* or the fore-part timber may be carried to form the head, or give any ornamental finish that may be desired. Additional strength and security are also given to the stern of the ship by filling in the hull inside the stern-post with a water-tight bulk-head *i*, of solid timber; beyond the stern-post the timbers and deck may be carried out to any extent desired to form an overhanging stern, as partly shown at *g*. Now, should this portion of the ship be carried away by collision or the force of the waves, the strong partition *i* will preserve the vessel from further damage by the ingress of water. To add to the strength of the upper part of the hull, on the inner side of the frames, and level with the deck, we attach strong double waterways *p*, *p*, of oak (fig. 2); these are carried round the vessel, and firmly bolted to the ribs and beams, and to these the bulwarks are secured, so that on the ship being struck the additional resistance of the double waterways are offered to the opposing force; and, the bulwark staunchions being within the outer frames, and through the oak waterways *p*, *p*, are not so liable to be carried away, as the bulwark is kept clear of the sea when the ship is under canvass. We give to the keel the form of a double arc, as shown at fig. 4, tapering it off at either end where the reduced weight is advantageous.

Having endeavoured, Sir, to show what I have aimed at, and how I have gone to work to obtain my object, it only now remains for me to explain with what results; and first as to strength:—

Reference to the diagram will show, that by the combination and position of the several portions of timber composing keel, stem, stern-post, dead-wood, and the actual crossing of floors with the curved kelson, when kneed up to the stem at one end of the ship, and the water-tight bulkhead and sternpost at the other, that an immense amount of strength must be

obtained before a single plank is wrought, every one of which (in proportion to its substance) adds to it, as do also the butting of the timbers, for, being cut from a centre, like the felloes of a wheel, longer on the outside than on the inner part, you have but to keep them to their position, and they will bear any reasonable amount of pressure; instance the wheels of large timber-gins (which are not half the substance of half a single frame of a ship), jolting over uneven surfaces, sustaining sudden shocks with heavy loads, which their form alone enables them to bear. The planking also round the whole body, like an extra ring of bricks or stones to an arch, is adding to this strength, so that when all is properly wrought, fastened, and caulked, it is next to impossible to force the bottom or sides of ships so built out of their position. Then we gain another very important advantage by breaking the line of separation at the heads and heels of the frame timbers, which, if it be correct to argue that nothing is stronger than it is in its weakest part, ships of the usual build, so far as this separation affects them, can only be said to be half as strong as they appear to be. The shift of timber to which I am referring is consequent upon the formation of the bottom causing the heads and heels to rise one above another.

But, further, as a proof of strength, I beg to state, that I saw the "Margaret" (I think it was on the day before launching) resting, as this model now does, on a single support in mid-length, 50 feet of her fore-body being sustained by its own strength alone, without the least injury. I well remember the foreman's reply to my observation, that it was "rather a severe test." "Oh, that won't hurt her; you might hang another 'Margaret' to her bowsprit and she would bear it." This, Sir, shows longitudinal strength. In support of general strength, allow me to adduce the evidence of Mr. B. Beckwith, a man of integrity, well able to judge and form a correct opinion: he sailed in her for about twelve months, and writes to me, "It is with pleasure I forward to you my testimony as to the merits of the 'Margaret.' It is my firm conviction that she stands unrivalled in strength, speed, and stability. When under a pressure of canvas in a seaway she does not show those symptons of weakness (by the creaking noise) that is usual in most ships; on the contrary, she is almost as quiet as if lying in a dock. During the time I was in her, I never saw the least movement, either abreast her mast, waterways, or anywhere else."

But her strength (as if to afford evidence to suit my purposes) was subjected to another kind of test, perhaps the greatest that the combination of hull and dead-wood could be put to.

On her second voyage, being bound to London, loaded, and in charge of a pilot,—somewhere above the Nore he managed to get her upon one of the sands; it was on the first of the flood-tide, which, setting on to the sand (the vessel drawing eighteen inches more water aft than forward), necessarily carried her head-on. Instead of holding this vessel stern to the tide, until there was sufficient flow to swing and bring her head at it, he let go her bower-anchor underfoot, and veered away cable till it was almost all out; he then held on, and she canted a little, and moved a little, until she was held athwart the tide by her cable and anchor at one end, and her heel on the ground at the other, the whole force of the strength of the tide being on her broadside. She was laid in a proper place (after this was

known) to examine her, when it was found that she had sustained no further damage than the anchor had occasioned, by ripping off a little of her copper.

I adduce, as another instance of strength, the fact that, the "Laughing Waters," when being towed from Antwerp in ballast, being caught by a sudden and severe gale of wind, the steamboat not possessing power sufficient to prevent it, took the ground on one of the shifting banks, which dried at low-water. When the flood made, the sand on one side of her began to scour away until (as the Captain told me) a hole was formed nine feet deep, into which she rolled, easy as a cask would have rolled into it: had this happened to a ship of usual build, is it too much for me to say, her floors, if not her back, would most likely have been broken? But this ship, when docked in London, was found none the worse for this severe trial.

I will, Sir, by your permission, read the opinion (on this point) given in writing by a shipbuilder of an eminent firm in the port of Hull, also that of another practical man well known in London, and in Her Majesty's service.

February, 1860.

I HAVE been on board the "Sisters," as you requested; from what I can see of her afloat, her form is calculated to impart *great strength*. I think she would scud before the most violent storm; but fancy her stem being so much under must be against her going to windward.

April 25th, 1860.

MY opinion as regards your mode of building is, that it is true as the Gospel—*nothing can equal it for strength.*

A SHIP'S CARPENTER IN THE SERVICE.

This, I hope, will be sufficient to prove that we have not failed to secure in vessels of this build, great strength.

Now, as to capacity with relation to the materials used, very little, I presume, need be said on this head; as—

The figure employed is that which affords the greatest capacity; but as some persons have doubted, and others have denied this, I adopted a simple and convincing illustration, by causing two pieces of metal to be cut, of like size and shape, one piece fashioned into a square, the other into a circular form, to be measured one against the other; I need not add with what result. Yet, in one instance, such is the effect of prejudice, I heard a person, after such trial, declare there was something wrong about it; he would not believe a circle to be as large as a square. I suppose it must have been something of this kind that gave birth to the proverb,

> He that's convinced against his will,
> Is of the same opinion still.

But to come a little nearer to actual practice, Will these vessels, said to be so fast, carry a remunerating cargo? Now, Sir,—as 100 cube feet is computed to be a ton register,—NM is 100 cube feet; vessels of like tonnage, if filled with anything that would run into every part, must be found to hold a like quantity, but, as this 100 cube feet is in vessels of divers form, if filled with goods that will not accommodate themselves to every form, it follows that those of most convenient shape must have the advantage; hence the very fine lines of the entrance and runs of many

clipper-built ships are against them, and have led to a widely-spread opinion that but very little space can be had in combination with great speed. With such conclusion I am at issue, being borne out by facts patent to any who will take the trouble to investigate them. Allow me, Sir, to read you an account of cargo shipped on board a vessel of only 491 tons register, in the London Docks, and safely delivered from her at Hobart Town, with which cargo on board she exceeded 16 knots under sail.

London,
November 6th, 1858.

SIR,—Inclosed is the tonnage of the "Laughing Waters," Captain Lay, per Hobart Town, consisting of 104 tons weight, 16 tons liquids, 857 tons measurement, total 977 tons, in addition to which she had a deck load of timber for cranes, &c.

(Signed) RICHD. WEBB & Co.,
32, Leadenhall Street.

G. R. TOVELL, Esq.

Hear also the Captain's account of cargo and speed after his first voyage in another vessel (which is now in the London Docks loading general cargo for Mogador). This vessel, "The Sisters" of Portsmouth, is but 128 tons, and only 105 feet between the perpendiculars.

Fresh Wharf, London,
November 6th, 1859.

MR. TOVELL,

SIR,—In haste I now write to inform you of our safe arrival, after a very boisterous passage, but I am happy to say our ship is a *wonderful sea-boat;* we have been able to sail with a gale of wind and average ten miles an hour, when other ships had to "lay-to."

We were very deep on our outward passage, having in 216 tons of patent fuel, and have brought home 180 tons gross weight, or about 127 of net fruit, which is coming out in excellent order.

We were out of trim coming home, being *a foot too much by the head;* this made her require her head-sail so long that we carried away our jib-boom, and were *seven days without one.*

The ship has given me every satisfaction; she is a powerful vessel and a wonderful bad-weather one; below, in a gale of wind you can scarcely feel her; she ships no heavy water, and *scuds beautifully*, and when in trim is as handy as a boat; she has little or *no pitching motion;* much as we were by the head we never put our bowsprit in, and you know it stands very low.

I intend putting a false keel on her, and I believe she will be the *fastest boat afloat*, to or off the wind. We have got as much as thirteen knots out of her, and I am quite confident she is able to go fifteen.

I must tell you what she did in the Channel; we came from *Dunnose to Beachey Head* in three hours and forty-five minutes, tide against us chief of the way.

A fine vessel was boarded off Dungenness *two hours and a half* BEFORE us; we were alongside her in four and a half.

I remain, dear Sir, yours truly,
J. T. STEEL.

Schooner "Sisters,"
of Portsmouth."

N.B.—This vessel is but 128 tons register; 105 feet long between perpendiculars.

The brokers, Messrs. Knell and Co., Pudding Lane, who did the business in London for this vessel, after she had delivered four cargoes, told me she put out the most for tonnage of any they had had this season.

These things go to prove that the form is good for stowage; and, what is another advantage with the merchants who have employed them, they stand first for charter, and sometimes at a little extra freight.

I come now to speak more particularly as to speed; and, that I may

afford myself opportunity to put before you, Sir, and this assembly, some of my notions, which may not be found uninteresting, allow me to put, and to answer, a question, viz.: "Why should these vessels go faster than other clippers of like dimensions?" My reply is, That from the form of the forebody, from the load water-line to the keel, every foot of length is making, and only making, its due proportion of displacement for the free passage of the largest or midship-section. This I think cannot be said of any other form of entrance.

In the second place, the direction given to the passage of the water under the forepart of the vessel is found in practice actually to lift the ship; so that, instead of accumulating about the bows or around her, and forming an obstruction, it causes a decrease of the submerged area of every section from forward to dead-flat.

In the third place, I hold that, as soon as the ship is put in motion a-head, the preponderating weight of the after body over that of the fore, of the weight of cargo abaft dead-flat over that before it, with the addition caused by the lifting of the bow, all aid the onward progress of the ship.

In the fourth place we have not a foot of straight below the load water-line, which, in a sea-way, whether found in the bottom or sides of a ship, is necessarily a hindrance to speed.

And lastly, in addition to the reasons stated, is the fact, that with every ton weight put into these craft you gain an increase of length and breadth to carry it, still retaining an unaltered form for rapid passage through the water, so that, if canvas could be increased with cargo, these ships would always go faster loaded than they could when in ballast trim, as we find they do now in strong winds.

Being convinced that to these things we owe our great speed, I give them as an answer to the question, "Why should these vessels go faster than other clipper ships?"

On what other principle are we to account for a vessel only 160 feet long (indeed not that at the water-line), and 24 feet beam, reaching fifteen knots, and another, only 166 feet long, with 34 feet beam, exceeding sixteen knots as deeply-laden ships, rather (as merchantmen) under-rigged, and with no steam-power to help them; and, I pledge my word, Sir, that on the first day canvas was set upon the "Margaret," wind blowing fresh, with rain, being timed by a-stop-watch from beacon to buoy, she was found to have performed the distance at the rate of fifteen knots an hour under three sails.

The testimonials of many different persons go to show a like speed.

On one occasion, after giving the racing yachts a start of twenty minutes, with the wind and tide strong in their favour, and during the race giving way, so as not to interfere with their sailing, she came in a-head of the headmost yacht. I was on board her. We did not set our topsail till off Gravesend, and had but an ordinary crew to set canvas, and to *get*, not to *slip*, from our own anchor, which would not have been the case had she been racing.

The same day, being under the lee of the steamer "Petrel," that vessel being then at full speed, she hauled her wind, and luffed across her bows, walked out to windward, and passed her with ease.

The *Times* of 24th May, 1858, giving an account of a match sailed

about that time, states, that the distance (from Erith to the Nore and back) was performed in 5 hours 39 minutes, and that it was the fastest on record.

I have a P.S. in a letter written by Captain Beckwith, to this effect: "In my previous note I should, perhaps, have stated that the 'Margaret' sailed the match course from Erith to the Nore and back in four hours and eighteen or twenty minutes, I forget which, but I question if that was ever done before or since in the time."

This gives our cargo vessel 1h. 19m. advantage. Again, according to the *Times* of the 15th February, 1854, the "Great Britain" arrived at Liverpool on that day, and reports "strong winds from E.N.E. since passing the Azores."

The "Margaret" left the day the "Great Britain" passed the Islands, and landed her letters at Hastings on the 14th, being the day before the steam-ship reached Liverpool.

The owners of the "Mignon" of Liverpool (one of their fastest fruiters), acknowledged to me that the "Margaret," for several successive days when off from the roads of St. Michael's, in consequence of strong weather, did sail round her, having her foresail to windward, or aback, and the present owners of this extraordinary little craft (the "Margaret") having stated, in the year 1855, that she had given them every satisfaction, having made her passage from Amberir, in 7° south, to Liverpool (a difficult passage to make) in 40 days,—seldom, if ever, before made in less than 60 days,—write again, in 1858:—"In reply to your inquiry, we have much pleasure in stating that the 'Margaret' continues to make her rapid passages as usual, and is everything we could wish;" their Captain clenching the whole by declaring "she is the fastest piece of wood ever put upon the water." Now, can anyone be surprised at the character I have given her in the following rude lines—

Whoe'er with this vessel shall once cross the seas,
I am sure with her actions can't fail to be pleased;
"Off the wind" like a phantom she flies from the rest,
But when brought "upon it" she proves herself best.
A lee-shore you fear not, whilst she carries a rag,
For over the billows she bounds like a stag.
She has power like a frigate; speed like a "well-bred;"
To her canvas she rucks not, and steers with a thread.

You can make allowances, Sir, for a father's description of his own child; but it is not to be forgotten that, if he will speak truth, no one can have a better knowledge of that child.

"Laughing Waters," per Log-Book, when loaded.

1858, March 13th, 8 hours, 15 knots; 4 do. 14; 4 do. 12: days run, 288.

1859, January	25th,	days run	225
,,	20th,	,,	233
,,	27th,	,,	334
,,	28th,	,,	243
,,	29th,	,,	216
,,	30th,	,,	200

The Captain writes, It is no unusual thing with us at eight o'clock in the morning to see a sail a-head as far as we can make her out, and to have

her as far astern by four in the afternoon. The crew also assert that in the squalls she has made 16½ or 17 knots off the reel, and by patent log; that she steered like a boat, and, well handled, would do anything. The Captain says, "I can, now I am used to her, make her do anything but speak;" he also told me that a little boy, who was obliged to stand on the carpenter's caulking-box to enable him to see the compass, could run her under double-reefed sails.

I have nearly done with this part of my subject, having only a few words about the little "Silver Star," which I consider spoiled in order to comply with Club rules of admeasurement. She has too little beam to get all the advantages of the system. She sailed three matches; one at Walton-on-the-Naze, and two at Harwich. In the first she won a silver tankard, beating the second boat half-an-hour. At Harwich she took thirty sovereigns, competing with the "Oriel" of 25 tons, the "Eva" of 20 tons, she being 25 tons; the "Eva," a fine little craft, was second yacht in. This was no day for sailing, as you will suppose, when I tell you it took six hours to do twenty miles. This led to an arrangement between Mr. Hope, the owner of the "Eva," and the owner of the "Silver Star," for a trial over the same course on another day named, on which there was a fine sailing breeze, and a good deal of interest was excited: they started, and at the first station the "Silver Star" had gained five minutes; at the next, ten; and at the last, twenty; so that her superior sailing qualities were admitted, the advantage not being the effect of a favourable puff, as is often the case. The "Eva" was built by the justly-celebrated Wanhill of Poole, and considered a fast yacht.

Surely, Sir, it is worthy of note, that all these advantages, great strength, large capacity, and a few extra knots at the difficult end of the figures (for, whilst it requires but little effort to get 10 or 12, it becomes quite another problem to add materially to it), involve no extra cost, being solely the result of form, which is always telling, and sometimes, as is well known, is the sole cause of safety, as opposed to total loss: instance the case of two ships caught in a sudden gale of wind when close upon a lee-shore, one a moderate sailing vessel, the other from her formation very fast; the smallest storm-sails, we will suppose, are all that will hold together; it becomes an effort for life,—for it, with the safety of ship and cargo, hangs in the balance, depending entirely on the sailing qualities of the ship. Now, when we speak of value, who in all this assembly can estimate the difference in value between the whole combined qualities of the two, if one, by her ability to clear the coast is safe, whilst the other, failing to do so, becomes a wreck, and her brave fellows, who richly deserve more concern for their safety than is generally manifested, perish. I hesitate not to affirm that a very large proportion of ships that strew our coasts every year, are lost for want of sailing qualities. Coasters, of all other ships, should be fast, for they are always necessarily close to the land.

Again, in the calculation for everyday work, it should not be forgotten that two knots an hour speed possessed by one ship over another, in a passage of 70 days, gives 3,360 miles to the good, and that, to bring up this, an ordinary vessel, supposing her to maintain during the whole time 6 knots, would require 23 days, in which time the faster one would be 4,416 miles a-head of her. It is—I feel it to be so—almost impossible to

calculate all the advantages of speed in ships; but look at the bulk of our ships in this respect,—from 3 to 6 knots on a wind, and from 7 to 8 or 9 free, are their rates. Why should this state of things remain? A ship is not like a house; if she is a bad-conditioned one, spend no money to prolong her existence; wear her out, and build a good one.

Sir, these are the elements, and some of the results, of a very simple and inexpensive system, which do indeed involve advantages too numerous to be touched upon in so short a lecture.

May I now call your attention, Sir, to the models on the table? This small model shows—I think it will be, as it has been, admitted—that elegance can be produced upon this system; it would make a very fast and comfortable yacht, and, when no longer required for that purpose, be a saleable property at the market-price of merchant ships, as she would at any time make a first-rate fruiter. I think, for many reasons, it is to be regretted that gentlemen do not determine that the entire outside measure shall be taken (as the inside is in merchant vessels) for ascertaining the tonnage; it would leave every designer free to use length, breadth, and depth, according to his judgment, which now has often to give way to Club rules, as was the case in the "Silver Star."

The sectional model on an inch scale, 155 long, 26½ beam, 15 deep, about 285 tons register N.M., 495 old or builder's measure, length of keel 127 feet, would make a very nice little West Indiaman, in which trade merchants prefer smaller ships than formerly.

The painted model is intended for a 1,160 ton ship.* Her dimensions: extreme length 200, breadth 33·4, depth 20, length of keel 171 feet (N.I.).

I now come to these models of men-of-war, and I really wish my partner, Mr. William Miller, R.N., who has produced them, and who, having spent some 25 or 26 years in the service, is necessarily better acquainted with what constitutes a good man-of-war than I can be, could have given his own description of them, for I fear that I shall not be able to do him justice; but I have this satisfaction, to know that the models are before those who, almost at a glance, can do so. I will therefore simply state, that this model has between 9 and 10,000 tons displacement; is designed to carry 52 of the heaviest guns on the main deck; to be cased with upwards of 2,000 tons of iron on her sides and decks, to resist as much as possible shell, and even solid shot; and to possess sufficient stability to carry all this enormous weight, together with 1,000 horse-power engines, coals, stores, and provisions for 700 men (fully considered and calculated), and to retain all the essential requisites of an efficient man-of-war, that would enable her to be superior to any one of the larger line-of-battle ships, especially in heavy weather. Mr. Miller has carefully, and with deep interest and solicitude, studied this subject, during and since the siege of Sebastopol. He thinks the improvement of our men-of-war to be more in appearance than in reality; that in bad weather they are not even so good as the ships of olden times; that they cannot keep the sea so long. He believes this system may be adapted to all classes of ships of war, and that they would in no way be inferior, not even in appearance; on the contrary, that to use the system in our naval yards would give us very superior ships in every respect,

* A vessel we purpose to build.

while it would enable them to be constructed cheaper, quicker, and stronger than ships of the ordinary form.

You will observe that he has placed the screw further forward than is usual, as this can be effected without diminishing its diameter, and the advantage is, that the propeller is more out of the way of wreckage, &c.

He has also made provision for closing the screw-well (which method practical men think simple, strong, and effective) with slides working in a metal case, which are intended to be flush with the outside planking (not as seen in the model, which merely exemplifies its working). The slides have a rack fixed to their upper surface, which is acted upon by a bevel pinion wheel, worked by one man by means of a vertical shaft passing through a stuffing-box on the orlop-deck; its object is to prevent the drag of dead-water impeding the speed of the ship.

From experience, I find that vessels of the form I advocate will carry their weight higher up than those of ordinary build possessing the same length and breadth; that they sail much faster and steer better, are first-rate bad-weather ships, and will scud in heavy weather, and ride, or lie-to, admirably.

They are very easy of construction, capacious, and strong.

They require less curve in their timber, and less timber to obtain the same space; less labour is required to bend the planks into shape, and steam is not wanted; for which reasons this form costs less.

Surely these are advantages; and whenever private gentlemen, or those on whom the heavy, and I may add unenviable, responsibility devolves, of deciding for national purposes what is best, shall desire, I can only say for myself and my partner, Mr. William Miller, that we shall be happy to afford them the opportunity to avail themselves of them.

The price of ships, like most other things, varies with what affects the value of the materials they are constructed of, and that of labour; but I affirm, without fear of contradiction, that 100 cube feet, or "a ton register," which everybody can understand, can be produced by this system as cheaply as by any other. In thus speaking I am safe, for I believe it has been produced for less.

I have only further to tax your patience, Sir, by stating, that, without exception, all the gentlemen who have tried the system are satisfied; and, as a proof, one or two of them have come forward with some others to open a yard to promote the building and more general use of ships built on this principle, and this yard I do hope, ere this summer passes away, to see in full operation; we now only require the patronage of a few more gentlemen, thus to promote, not only what bids fair to be a more than self-supporting system of improvements in ships, but one that would confer on shipowners, merchants, underwriters, and last, though not least, sailors, a real benefit.

In conclusion, I most sincerely thank you, Sir, and the Gentlemen who, with yourself, have done me the honour of so patiently listening to my very homely remarks and explanations.

Friday, June 1st, 1860.

W. STIRLING LACON, Esq., in the Chair.

RECREATION, WITH REFERENCE TO THE SANITARY CONDITION OF THE ARMY.

By Captain E. S. Jervois, Commandant Military Convalescent Establishment, Great Yarmouth.

"All work and no play makes Jack a dull boy!"

This is an old maxim, but admits of no contradiction, and I think it will generally be admitted that there is no individual to whom it more fully applies, both mentally and physically, than to the soldier.

It may occur to you that so much has already been done towards the moral and intellectual improvement of the soldier under the present administration, and that the importance of the subject is so well understood by the authorities generally, that there is little need for referring to it at all.

In responding, therefore, to the request of the Council of this Institution to read a paper on "Recreation, with Reference to the Sanitary Condition of the Army," it may be necessary to remark, that my object is mainly to endeavour to show the advantage that might accrue, if the measures now in use could be considerably extended, so as to establish one wide and uniform system of amusement for our army in all situations.

I am quite aware that many commanding officers of brigades and regiments have done much in promoting amusements for the men under their command, and that many valuable suggestions from such quarters have been put aside by the authorities, on account of the expense they would involve. But, if the subject is well ventilated and placed before the public, I entertain no doubt of its being received with a generous approval, especially as it might be shown, I conceive, that any outlay in these matters would in the end be recognised as a wise and remunerative economy, inasmuch as it would tend to reduce most materially the number of sick, to improve the character of the soldier, and make him desirous of prolonging his service, instead of wishing to quit it after his first period.

That such results are attainable there can be little doubt, and it therefore becomes a duty that every one who has the command or management of soldiers should devote his attention to discover the means which are most likely to lead to those ends.

In proceeding with the subject I shall bring before you the remarks and opinions of several persons who are identified with the cause; by which it will I hope be seen that their views terminate in the objects I have suggested.

To effect much benefit to the soldier, rooms must be provided for him presenting greater attraction than the public-house; let him have the canteen at hand as a place of refreshment only, and, destitute even of a newspaper, he should drink at the "bar;" so that the comparison with it and the "reading and game rooms," and even with his own barrack room, should, by affording ample amusement and cheerful companions, always be manifestly in favour of the latter. Such desirable ends, however, can only be accomplished by some general plan, both as to accommodation and the means of recreation, instead of those which exist at present, viz. that a regiment frequently finds itself placed in a town in Great Britain presenting every temptation to drunkenness and vice, very indifferently provided with barrack accommodation, and with no inducements whatever for the soldier to remain in his quarters.

Similar remarks may be made in regard to hospitals, especially those of a general kind, where men are detained for considerable lengths of time; this has been fully exemplified in that at Yarmouth, and doubtless in many others where attention has been directed to the permission of games, &c., for the men.

It appears to me, therefore, that a general scheme should be organised embracing barracks, standing camps, hospitals, and troops in the field; the latter for obvious reasons would of course be subject to limitation, but should by no means be excluded.

Objections may be anticipated as to expenditure and increase of "train;" those objections however would soon vanish were the experiment made; and we have already seen enough, from the limited measures now in practice, to authorise the assertion, that great and valuable consequences are to be anticipated from their expansion and application to the soldier in every situation.

To carry out this scheme it would be necessary to erect buildings, permanent or otherwise, upon some well-approved plan, at every station, barrack, or camp, for the use separately of each corps or brigade.

In these I would have every inducement placed for the soldier to pass his leisure time in a beneficial manner, keeping distinct the rooms allotted for reading from those in which games or other amusements are practised, so that the men employed in the latter may, without annoyance to those engaged in more quiet occupations, pursue their amusements without any restraint on their hilarity; for, unless the soldier is unrestricted at such times, his enjoyment is materially diminished.

The first opportunity I had of witnessing the extraordinary results of the advantages of games and amusements, as applied to sick soldiers, was in China in the year 1851.

The 59th regiment, then quartered at Hong Kong, was more or less affected with disease throughout its entire strength, partly from the deadly effects of the climate upon the European constitution, but principally from a free indulgence in that most pernicious liquor called by the Chinese *sam shu;* and the *morale* of the men was at so low an ebb, that they did not appear to care what they did or what became of them.

Through the obliging co-operation of the senior naval officer on the station, the old "Minden" (74-gun ship) hulk was placed at the disposal of the general commanding as a convalescent ship, and was furnished with

games of various kinds, newspapers, &c. The sick were sent on board in detachments, as they became well enough to leave the hospital, and remained there until considered fit to return to their duties.

A similar plan of recreation was adopted on shore; ball and racket courts, cricket, foot-ball, quoits, &c. were provided for the men, and in a comparatively short time the garrison assumed a totally different aspect; the men, instead of assembling in the *sam shu* shops, were to be seen enjoying the amusements provided for them with the greatest alacrity and cheerfulness, and the result was that the moral and physical effects produced were most surprising.

I will now pass on to the year 1858, when, in consequence of the number of invalids and wounded soldiers who were constantly arriving from India, it was considered necessary by the authorities to provide a convalescent establishment for their reception; and, the Naval Hospital at Yarmouth being at the time unoccupied, it was opened in the month of April of that year, and has continued in use with the most advantageous results; having had at intervals as many as three hundred patients under treatment, and at one time there were soldiers of upwards of one hundred and ten different regiments on the strength of the establishment. The hospital is one of the best in the kingdom, covering a space of about ten acres, and close to the sea. It was well supplied, and the utmost care, attention, and kindness, were bestowed upon the patients by all around them; yet, such was the lassitude felt by all, under the unavoidable confinement within the walls,—although its centre contains a fine garden, and there is a terrace overlooking the sea, on which the men are permitted to walk,—that they became dissatisfied, and were continually asking to be sent to their depôts, or to be allowed to go on furlough to their friends; notwithstanding that they were well aware their cases still required the best and most skilful treatment, as well as generous and expensive diet, with rest and quietude, and that their friends or relatives had not the means of furnishing them with these requisites. The question arose, to what was this to be attributed? Purely to the absence of amusement or employment.

The means adopted to remedy the evil were these. Two large rooms, each about forty-three feet long by twenty-four feet broad, and in close proximity to each other, were set apart, one as a reading-room and library, and the other as a game-room; both these were ornamented with flags and pictures of battles and portraits of distinguished men.

The reading-room was liberally supplied by the authorities with books, newspapers daily, and periodicals.

The game-room was also supplied with chessmen, draughts, solitaire, backgammon, and dominoes; and there were only two other games considered necessary to complete the list, a bagatelle and skittle board, which were supplied from a private fund, together with telescopes and writing materials.

The effect produced was quite marvellous; the games were pursued with the utmost avidity, and the tone and manner of the men became entirely changed. Their time no longer hung heavily upon their hands, cheerfulness and contentment were restored, and they ceased to make application for removal, until the medical officers considered them fit to leave.

Having, I trust, distinctly shown the benefits which accrue from the

introduction of games and other recreations amongst the sick and convalescent, I will next advert to the advantages which might be expected, if the same system were adopted with soldiers who are not sick, in the common acceptation of the word, but who merely suffer from the *ennui*, or lassitude, consequent upon want of employment in their leisure hours.

The manner in which our soldiers are comparatively thrown upon their own resources for amusement, and consequently the amount of crime and disease, principally attributable to drunkenness, simply caused by want of other occupation, can hardly have escaped the observation of those who have lived in a garrison town, or in the neighbourhood of a camp.

A general officer, writing in the Journal of this Institution, remarks, "Neither officers nor soldiers are always provided with means of healthy recreation."

Could not a portion of the spare time of the former be devoted to the superintendence of, and participation in, the recreation of the latter, with the most advantageous results to both?

There is, perhaps, nothing which will so much influence the soldier as any attention which the officers may choose to bestow upon him. It is quite natural that it should be so, for directly you have succeeded in establishing your own mental superiority over the soldier, from that moment you gain his respect; again, as soon as you obtain his confidence, you find that he is ready to comply with your wishes, and do his utmost to serve you. But how is this superiority and confidence to be attained?

First, by proving to him the advantages of education, and taking every opportunity of imparting those advantages to him.

And, secondly, by using your utmost endeavours to show him, that you really take an interest in his welfare, and do everything in your power to relieve the monotony of his existence.

Now a soldier of the present time, after a short experience in the service, becomes a very clear and practical observer in all that concerns himself. Raw recruits in most cases pursue a thoughtless course for one or two years, but subsequently they look around, and begin to perceive the advantages that the well-conducted are enjoying, the increase of pay, &c. attainable by good conduct, and they scan everything that is presented to their attention carefully, and are keenly alive to its advantages or the reverse; and, when you have once impressed the soldier with the conviction that the measures in which you profess an interest are really likely to be productive of benefit to him, he will readily adopt them, and, as before stated, gratefully accept your agency in his behalf.

I have often found that many soldiers who at first look upon games such as chess or draughts as too difficult of comprehension, or too dry to be amusing, were gradually induced to learn and practise them among their comrades in a room at the barracks, and soon found great relief from such occupation and amusement; and herein is a strong reason for placing such recreation within their reach, so as to draw them off from amusements of a more criminal and destructive tendency.

They do not object to learn them under the eyes of their comrades, when they would not attempt to do so before strangers in places of public resort. It is simply to give them easy access to a place where they will

find amusements at a nominal expense, and conducted upon a non-coercive system, and you will soon find that a soldier is not quite so difficult to please as some may imagine.

There are many who assert that a large proportion of the men of nearly all regiments are a noisy and dissipated set, who cannot be induced to attend schools or day-rooms; but this is the very reason why those who are not so, should not be left to their own resources to become noisy and dissipated also.

That soldiers will voluntarily attend lectures and amusements provided for them was proved to me by the following incident:

Attached to the military hospital at Yarmouth is a small detachment of effective men who perform various duties connected with the establishment, and after a certain hour are at liberty, like other soldiers, to make out the remainder of the day in the best way they can.

It is a remarkable fact that, during the past winter season, whenever a lecture has been delivered to the invalids, upwards of one-half of the above-mentioned detachment have invariably applied for permission to attend also, showing that they preferred an hour's rational amusement to the variety of inducements held out in a town like Yarmouth to spend their evening in drinking and dissipation.

When then you have thus once succeeded in convincing the soldier that there are other enjoyments which will afford him equal pleasure without painful consequences, from that moment you take the first step towards his moral improvement and individual excellence, which is after all the grand secret of an efficient soldier.

The days of old traditions are gone by, and if we intend (which I firmly believe we do) that our army should continue to hold its own, having thrown aside "Brown Bess," we should banish our corresponding prejudices, and teach the soldier to be more independent in action, and worthy of the weapon which has been placed in his hands; at the same time taking every care to ensure him the greatest amount of strength, agility, and bodily health.

In endeavouring to attain these objects, gymnastic exercises may be fairly estimated as a valuable agent; and on this subject I have been favoured with access to the Report of Colonel Hamilton, Grenadier Guards, and Dr. Logan, with reference to their use in the French and Prussian armies. Some extracts from that Report will be the best evidence I can lay before you:—

From Col. HAMILTON'S *Report.*

It is considered desirable that the complete gymnastic apparatus should be constructed, and every part of the gymnastic exercise, when the weather permits, be carried on, in the open air; but, as it is necessary to keep the men daily employed, even in bad weather, a building like a riding-school is also fitted up with some of the most useful apparatus, where the men can exercise at all times.

The total absence of injuries arising from these exercises, which is attributable to the methodical manner in which they are carried on, and the great activity displayed by the men who have gone through the regular course of instruction, leave no room to doubt that, were a similar system introduced into the English Army, it would be highly advantageous to the men. The following are some of the practical results of the exercises:

About twelve men were placed three feet apart, in two ranks, at a few paces from the foot of a perpendicular stone wall eleven or twelve feet high, which surrounds the magazine in the fort. At a given signal the front rank men ran towards the wall, and with the combined exertion of leaping, climbing, and vaulting they cleared it with as

much apparent ease as if it had been a five-foot wall; they were followed immediately afterwards by the second rank.

Walls averaging from twenty to twenty-five feet in height were scaled, either by means of long poles with a hook at the upper end, or the men would reach the top without any poles, by only taking advantage of occasional holes and irregularities in the surface.

Speaking of the gymnastic exercises in the corps of Sapeurs Pompiers, he says:

The activity, boldness, strength of muscle, and general expertness of the men, as displayed in their various exercises, speak highly in favour of the instruction they have received.

There appears to be an object in every exercise in which they are instructed, and each of them may be brought to bear in some one position in which they may be placed in their occupation as firemen.

From Dr. LOGAN'S *Report.*

From all, the experience gained in the French army is stated to be, that the results of the gymnastic system are to the effect of giving activity and freedom of motion, invigorating the health, proving a means of occupying the time of the soldier, and affording a variety from the more monotonous restraints of their ordinary military exercises, imparting to the many a feeling of confidence and self-reliance in the field, or difficulties of position, all tending to add to the natural impulsiveness, the acknowledged dash, of the French soldier.

These conditions may be viewed as abundantly recommendatory for the introduction of similar gymnastic schools and system in the British army; as means to prove very beneficial in a sanitary consideration, most certainly affording a relief to the soldier, from the little varying and therefore often wearisome routine of his ordinary drills, and by combining amusement with duty.

It would be for the authorites to prescribe the extent and necessary organization of a system of the kind.

It would prove an important sanitary advantage to the soldier to have his muscles and sinews braced up by such physical training.

Colonel Hamilton concludes the Report by observing—

It is doubtful whether the introduction of a regular system of gymnastic exercises, to form merely an addition to the drill of the English soldier, would be accepted as a boon; but it would not be difficult to make such regulations with regard to them as would cause their introduction to be looked upon as a relief from the monotony of a soldier's barrack life, while it would materially contribute to his health.

It appears therefore that the practice of gymnastics should be introduced more as a recreation, and, if as an established system, that it should be voluntary, rather than compulsory: the constitution of our army being so different to those of the powers alluded to in Colonel Hamilton's Report.

It is scarcely necessary to comment on such amusements as cricket, quoits, foot-ball, fives, and other out-door games. Their advantages are already thoroughly admitted, and I would here beg to refer to notes on the subject by Colonel Lindsay of the Guards.

Fives Courts.—When well-managed, I have found them much used in summer and autumn. They sometimes fail, as the men lose their balls, and it is nobody's business to provide them for sale to the men; but, when this has been done, the men are glad to have the recreation. Fives courts have been erected at several of the large barracks in the country, and with success.

Skittle Courts.—At Dublin, in the Royal Barracks, there are two provided for the regiments therein; but they are not generally provided by Government. Whenever out of London, I have always induced the officers to bear the expense of establishing two for the men, and it has been attended with full success.

Gymnastic Exercise.—(About to be established.) I believe that I originally was the mover in this direction five years ago, at Aldershott; and in the House of Commons, on

Army Estimates, I applied for and succeeded in getting wood and iron allowed to erect poles and bars; but, my battalion being removed, I never used them. If conducted upon a regular system (that is, a course of systematic instruction), it is calculated to afford not only recreation, but the development of the physical faculties of the soldier in many points most essential to him.

Draughts, Dominoes.—I got each captain of my battalion to give his company three sets of each of these games; they are much used, particularly in winter.

Chess.—Very few I find can play.

Quoits—Every captain of a company provides two sets of quoits. The men keep them up.

Games, Running and Hammer-throwing.—We constantly get up competition among the different companies; in addition to this, whenever at out-quarters we give a whole day for all sort of games. The officers subscribe from 15*l.* to 20*l.* towards this object.

Foot-ball is encouraged during autumn and winter. The effects of these various games when out of London is great. The in-door games have their effect in London; but the opportunity for those of an out-door character is small, and town life makes much difference in the habits of the men. But games and recreation have the best effect upon the spirits, health, and discipline of the men. It has the effect of taking away a sort of *ennui* which routine always *must* engender, and the monotonous life which a soldier in a garrison leads. It is calculated to make him more contented while serving, and to do his ordinary duty with cheerfulness, from a light-hearted disposition. I do not think too much can be written or said in favour of recreation. Eight hundred human beings cooped up in a small space, sixteen always occupying the same room, are likely to become worse by mutual contact and communication, instead of improving, unless something is done to counteract vice, and to make their lives pleasant. Recreation is one of these elements. Library and Reading Rooms, and opportunity for smoking in barracks, are the others, combined with regularity and discipline—in fact, to render a "second nature" caused by discipline, agreeable.

(Signed) J. LINDSAY, Colonel.

Now, it is the *in-door* and *evening* recreations I wish especially to direct attention to, in order that the barrack-room, or at least the buildings connected with it, may form a recognised *home* for the soldier.

If we look at the attractions prepared in all large towns in which he is quartered, to entice him into places of public resort, not merely "beer-shops" or ordinary public-houses, but those affording every species of amusement and temptation, such as billiards, cards, and dice, with music, dancing, and singing, we must find an all-powerful argument for increased exertion in providing amusement for him in the barracks, in such a manner as to induce him, if possible, to remain there during those hours after the evening meal which are left entirely at his own disposal.

And here it may be asked, What is there at present to induce him to do so, or to return to his barrack until the last moment, in comparison with what he finds in the places of public resort I have alluded to, and into which he is easily inveigled, and finds every inducement to renew his visit?

There are music-halls and concert-saloons at Portsmouth, Plymouth, Aldershott, and Yarmouth, and most other military stations.

It may be asked, How does the soldier find means to attend these places? It is not presumed that he can do so every night. But there is not the slightest doubt that a large proportion of the men in those towns and the camps seek such places of amusement, and spend their money in them, whenever they have any, and in too many instances are led to sell their necessaries to follow them up.

How important must it be, then, to provide a building close at hand, in which the soldier may find amusements equally attractive and less pernicious. Of its success no doubt can be entertained, more particularly in

winter, when he would gladly remain within the precincts of the barracks, rather than be at the trouble of dressing (as he must do) to go out. But, when he finds himself left in a dreary, dimly-lighted barrack room, destitute of amusements, he will, if he has a penny in his pocket, try to escape from it and join the gaieties of the town.

Should it be remarked that the library and reading-room is available to the soldier, it may be stated in reply, it is so; but our argument is, that the above-mentioned room, although valuable in itself, does not contain amusements sufficiently attractive or varied to induce a large proportion of the men to avail themselves of it. Some are incapable of using books or newspapers, by reason of inability to read. Some have not acquired a taste for literary pursuits, and *these* are the men who seek refuge in the town or public amusements, and who, by associations they incur, are led into drunkenness, crime, disease, and desertion.

To exemplify this I shall here introduce an extract from the Report of the Commissioners appointed to inquire into the "Regulations affecting the Sanitary Condition of the Army."

Colonel the Hon. J. LINDSAY *examined.*

5876. The question was put the other day to an officer, and he said that he did not see what the men would do with a day-room.

Colonel Lindsay.—We had a little experience of that the other day, before the new Wellington Barracks were occupied. There were two new school-rooms built in the Wellington Barracks for two battalions, and before the new part of the barrack was occupied the battalion that occupied the old part had the use of the extra school-room—and a very large room it was, I should think 50 feet by 30—that is, about double the space there is in any reading-room I ever saw attached to a barrack. It was watched to see whether this room would be used, and it was *crammed*, even that large room, so that there was not room for the men.

By the Committee,—Was it in the daytime or night?—Both.

Was it lighted with gas?—Yes.

What did the men do there?—They read and took their books there, and smoked.

Had they any games there?—Yes, draughts and dominoes, and those sort of things.

Do you allow cards there?—Never.

You do allow smoking?—Yes, we always allow smoking in our reading-rooms.

I will now read a letter I have received from an officer connected with Scutari Hospital during the Crimean campaign, and which I think completely confirms the evidence given by Colonel Lindsay before the Committee.

DEAR SIR,

I very much regret that the papers I have preserved give me very little assistance in answering your note of the 1st. All I can state is, that during the summer of 1855, when public stores became abundant, and the sick at Scutari were provided liberally with everything ordered for them; when, in consequence, the "Times Commissioner" (the kind-hearted and accomplished Mr. Stowe) could find no occasion for spending the private funds at his disposal any longer on behalf of the sick, he determined, on the recommendation of a friend, to get up a place of amusement for the convalescents forming the depôt.

There was at the time no place of recreation at Scutari for these men; and hence the low *raki* shops in the High Street were constantly crowded, and a large amount of drunkenness prevailed. The idea was warmly supported by Miss Nightingale, the General (Storkes), Dr. Lawson, and others; a committee was formed; a very suitable and commodious building erected; and a *café* opened, under the superintendence of an intelligent person engaged for the purpose.

The *café* was furnished with newspapers, books, bagatelle boards, chess, draughts, and

every other available amusement. From its opening it was well attended, and as long as it was under the management of the committee continued a great source of recreation to the depôt. Mr. Stowe died in Balaklava Hospital, soon after he visited the Crimea, in the same year; and the *café* was ultimately disposed of to a Greek gentleman.

During the winter of 1855, lectures were delivered by several officers and medical gentlemen for the instruction and amusement of the men. These were well attended, especially when the subjects were of an interesting character, and illustrated by experiments.

But there was one—I believe, only one—drawback to all these efforts: they were made at the expense of private funds, which were wholly inadequate.

Had the soldiers been furnished with the means and provided with the opportunity of spending their time, either at athletic sports or intellectual occupation, furnished liberally at the public expense, I believe an immense moral and physical benefit would have resulted, and much sickness and many other evils would have been prevented.

I now wish to introduce to your notice two plans, very simple and unassuming in their pretensions:

The first (Plate I.) is a plan of a building I would suggest should be attached to every barrack in the kingdom, and proportionate in size to that of the barrack. The exterior would be plain and inexpensive; the interior equally so, except that it would be fitted up with games of every description, and pictures of remarkable men. To this I attach great importance as having a tendency to raise the *morale* of the men; and I have found they take the greatest interest in the pictures, if they are of an attractive kind. A small refreshment room or bar attached, where the men could obtain tea, coffee, and tobacco at a low rate, and on the same plan as that adopted at Chatham, would also be a most desirable adjunct.

In this building, which I would denominate the "Game or Recreation Room," I would afford every facility for concerts, lectures with illustrations, competitive exhibitions of fencing, theatricals, &c. and would allow the regimental band to play on those occasions. I would have the games in the first instance provided at the public expense; and the men could subscribe 4*d*. or 6*d*. per month towards their support. I would engraft the room on the regimental system, and place it under the superintendence of a trustworthy non-commissioned officer, and make it the duty of the orderly officer and captain of the day to visit it whilst going their rounds.

The second plan (Plate II.) is on a more extensive scale, and is better adapted for a garrison or camp; combining gymnasium, library, reading-room, and game-room, also quoit and skittle grounds, rackets, and fives courts; but it is on too large a scale for a single battalion.

The next question I propose to introduce to your notice is, How are amusements to be adapted to the circumstances of an army in the field? At first sight it may appear almost an impossibility. If occupation for the mind and body be desirable in quarters, the same advantage may be looked for in camps on service; I would then suggest that marquees, solely for the purpose, should be carried and attached to the lines of each corps or brigade.

The expense of additional carriage will no doubt be objected to, as well as the difficulty at times of procuring it. Such objections ought not, however, to have sufficient weight to preclude arrangements being made for some means of recreation accompanying every force, even though its use might occasionally be interfered with or suspended in operation.

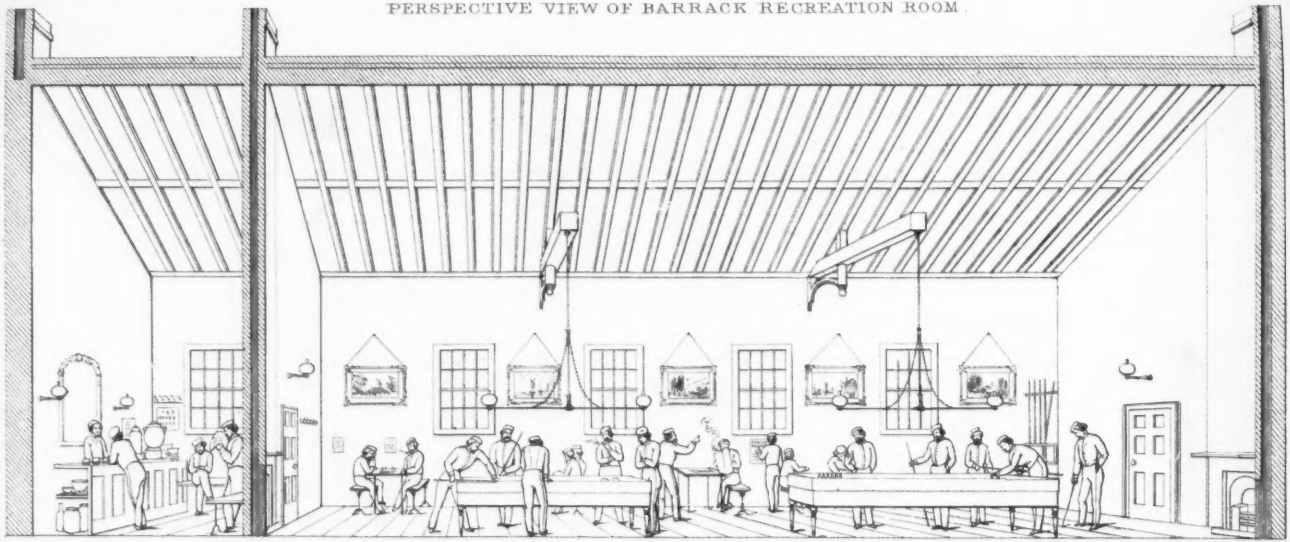
When troops on service are in motion their time is pretty well occupied,

Pl. 1.

PERSPECTIVE VIEW OF BARRACK RECREATION ROOM

To follow p. 8.

PERSPECTIVE VIEW OF BARRACK RECREATION ROOM.

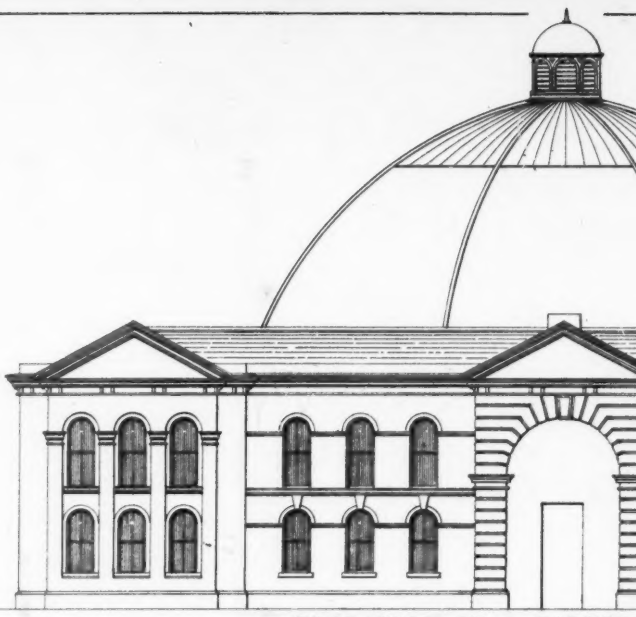


GROUND

PLAN

0 5 10 20 30 40 50 60 70 FEET

J.R.Jobbins



ELEVATION OF A GARRIS

Q u o i t G r
82'. 0" x 45'. 0

Fencing and
Sparring
47'. 0" x 30'. 0"

S k i t t l e s
41'. 0" x 15'. 0"

R a c e

Gymnasiu
High Mast
60'. 0" Diam.

Lectures and
Games
With Library and
Reading Room over
83'. 0" x 30'. 0"

16'. 0"

Caps and Coats

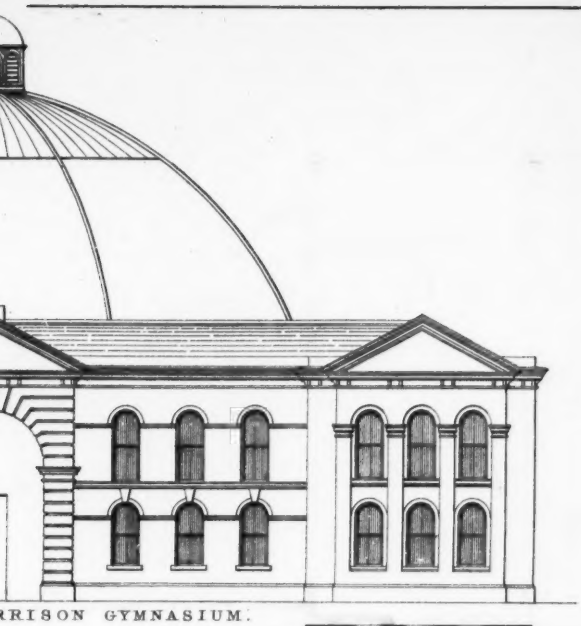
Stairs to Reading Room

Refreshment Room
28'. 0" x 12'. 0"

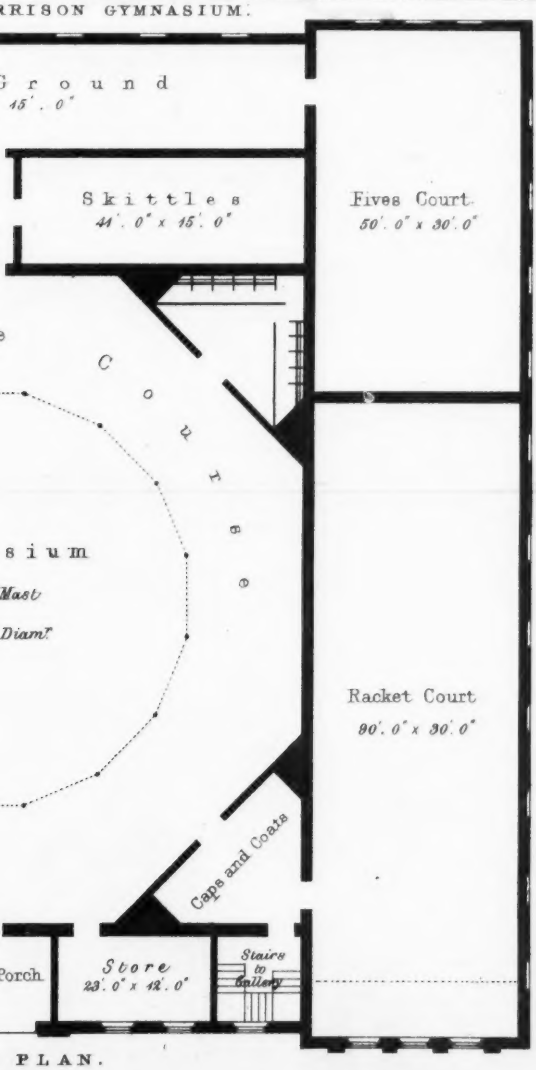
Entrance Porch

GROUND PL
Scale.

0 5 10 15 20 25 50



RRISON GYMNASIUM.



PLAN.

l e.

75 100 FEET

J.R.Jobbins.

and they are frequently too fatigued to need amusement. But when a field force remains stationary for any protracted period—Varna, for instance, where, I have been informed by medical officers, the deficiency of any mental distraction added tenfold to the horrors of the terrific outburst of cholera at that place, and which indeed may be collected from the published medical history of that war—the machinery for recreations would be eagerly sought after; men, under such circumstances, having but little occupation, unless employed in throwing up field-works.

The marquees should be furnished with games of every description, tea, coffee, and tobacco, with every facility for theatricals and lectures, and conducted, as far as possible, on the same system as the game-room in quarters.

Athletic games, also, should be established for out-door amusement, when the men are not required for any particular duties.

Results.

If marquees of the above description were provided and attached to every regiment in camp, it would be found that, instead of the soldiers, after the duties of the day, congregating in the canteens and other places of equally injurious notoriety, they would find inducements to amuse their minds in other ways.

Every army in the field will always have a large proportion of sick and ineffectives as long as the men are destitute of any kind of provision for their temporary comforts, and no attempt made to allure them from their present favourite haunts. A soldier's mind when unemployed in the field is in a state of vacuity and restlessness. He must go somewhere to relieve his *ennui*, and, having no place provided for him, he goes where he must inevitably contract the seeds of disease, and render himself utterly useless in his profession.

Were the experiment tried, there is little doubt that the results would be most satisfactory. The men would become more rational and expert, simply from not having imbibed the usual amount of bad liquor, and from having employed their time in thinking how they could play their next domino, draught, or chessman; which would also lead them to reflect before they wasted a rifle-ball in the air.

It may be adduced, that the marquee would be a great incumbrance to a regiment in the field; and, secondly, would cause great additional expense to the public.

In reply, it may be asked, Which would be the greater incumbrance—the marquees for amusement, or the marquees for the sick? Which would be the most costly—to have a large proportion of your men in hospital, and otherwise ineffective, with every kind of additional expense attending it, or to have an efficient body of men free from disease, and ready to march at a moment's notice?

If these two questions were fully entered into, it would in my belief be found, that both the incumbrance and expense of a marquee for the amusement of soldiers in the field would be more than counterbalanced by the expense and inconvenience of a large proportion of sick in hospital.

It is frequently adduced by persons familiar with the economy of hos-

pitals, that they pay their own expenses; the stoppage from the man, 10*d.* per diem, covering the outlay for diet on the aggregate. This I believe to be the case, so far as the subsistence of the man is concerned; but it must be borne in mind that, in addition to the loss of the man's services, hospitals are maintained at great expense in the buildings, clothing, stores, medicines, instruments, fuel, washing, &c. besides the pay and allowances of those connected with the establishments.

We may sum up, therefore, in a few words. The results of increased facility for recreation would appear to be:

1st. More amusement; less drunkenness.

2nd. Less drunkenness; less crime.

3rd. Less crime; fewer hospitals and prisons, and, consequently, a great increase of effective men, as well as less frequent recourse to flogging among troops in the field; and, I believe, an actual saving of money.

There is an old saying, "Penny wise and pound foolish." A cheap soldier is like a halfpenny doll purchased at a country fair, which falls in pieces directly its arms and legs are stretched; whereas, had a penny been given for it in a respectable toy-shop, it might have afforded amusement to the child "until it was time to put away childish things." If we, as a nation, want a "good article," as the shopman says, we must pay for it: and, could a better class of men, such as those who constitute the bulk of our mechanics, be induced to enlist, and then be supplied with every aid that art and material can give him, to insure his activity and health, both mental and bodily, I think it would be found that the proverb would be fully verified; and I believe most strongly that the extended plan of recreation I am now advocating would be found, not only a great inducement to such a class to enlist, but would subsequently render even this better class of recruit a more valuable and efficient instrument for applying our new, improved, and expensive weapons.

In the outset it was my intention to have gone into statistics and matters of finance, but to do so would perhaps prolong these remarks beyond their proper limits; and it would be difficult to arrive at any very accurate estimate of the outlay required to carry out a more liberal and extended system of recreation for the soldier under all circumstances.

It is sufficient at this time to bring the subject more prominently to view. Its own merits and decided claims to the consideration of the public are acknowledged by all who are in any way connected with soldiers; and, if that merit and those claims are put forth in a manner calculated to extend its benefits, they will unquestionably be encouraged and supported by the country.

In concluding these observations on the necessity for, and the advantages of, recreation, exercise, and instruction for our army, and which have, already, been in some degree established, I trust I shall not be trespassing on the position I am in, by expressing a hope for the success of those measures.

It is evident that the Government and those entrusted with our military administration are deeply interested in the matter; and that they are promoting and encouraging everything that tends to the welfare, comfort, health, and efficiency of the soldier. And I believe it is equally clear that they are circumscribed in their efforts, and that considerations of economy

are continually forced upon them, and operate as a check on their best intentions. This can only be remedied by liberality in the legislative bodies, and on the part of the nation.

I can scarcely hope that my feeble efforts will have effect, further than bringing the subject under notice; but they may be so far of service as to lead others of more weight and influence to take up the cause; and I am satisfied, it only requires to be plainly set before the public, to ensure their full and generous support.

At the present moment, the defence of the country is the all-absorbing topic, and surely no time can be more propitious for us to consider how we can devise means to render our army and navy our best and strenuous defenders.

Evening Meeting.

Monday, April 16, 1860.

Admiral SIR GEORGE F. SEYMOUR, K.B., in the Chair.

Names of Members who have joined the Institution since March 19th.

Hall, J., Capt., Paymaster 22nd Depot Batt.
Graydon, G., Lieut.-Col. Royal Artillery
Jebb, F., Capt. 67th Regt.
Pearson, C. K., Capt. 3rd Buffs
Pigott, F. P., Capt. 16th Royal Lancers
Butler, H. T., Ensign 58th Regt.
Hozeir, J. W., Cornet 2nd R. N. B. Drags.
Hutchinson, J., Capt. 8th Lanc. Rifle Volunteers
Vicars, H. J. A., Capt. 18th Royal Irish
Ouchterlony, J., Capt. Madras Engineers
Doorly, M., Quar.-Mas. 3rd W. I. Regt.
Lyon, F., Capt. Royal Artillery
Legge, Hon. A. K. H., Lieut. Royal Navy
Downes, H. F. Esq., Army Agent
Norman, H. W., C.B., Lt.-Col. Bengal Army
Clarke, A., Major-Gen. Madras Army
Webber, F. W. S., Lieut. 45th Regt.
Graham, H. A., Lieut. late 7th Fus.

ON FLOATING HARBOURS OF REFUGE.*

By Captain Claxton, R.N.

Abstract.

The Paper commenced by calling attention to the annual loss of life and property on our own coasts by shipwreck, which Captain Claxton said had for many years averaged eight hundred souls, while, through the wreck of the Royal Charter, and another passenger vessel, it had increased to sixteen hundred in the twelvemonth just passed. Connected as he had been with civil engineers, it had been propounded to him that their Institution was the proper arena for the discussion he hoped to elicit; but in that he did not agree, first, because he looked upon the subject quite as much, if not more, as a nautical than an engineering one, albeit he admitted the combination; and, secondly, because such was the nature of the Papers and Lectures read, and of the matters discussed, in the Royal United Service Institution, that for imparting knowledge he considered it second to none in this great metropolis.

The Lecturer then rapidly glanced at the evidence given on the question of harbours of refuge and shipwrecks before Committees of the House of Commons and Royal Commissions. He cited the evidence of scientific persons and the Reports of Commissioners down to 1859–60, of which Admiral Hope was chairman, and which recommended the expenditure

* Since the foregoing paper was read, a Committee of the House of Lords sat on the question of Floating Harbours, examined witnesses for and against, and ended by recommending that ten thousand pounds should be granted to the Admiralty for making floating experiments.—C. C.

of about two and a half millions of money for one or two harbours of refuge, on the East coast, another at the mouth of the Bristol Channel, and a few alterations or additions elsewhere of already existing harbours.

If the plan recommended by Captain Adderley Sleigh, and backed by several well-known nautical men, were found to answer, the sum of money required to be expended would, in seven or eight fathoms of water, be less than a fifth of that required for stone barriers, and in deeper water, while Sleigh's remained always a *constant* (except a few fathoms more of moorings), the difference of cost would increase, *pari passu* with the depth, up to twenty fathoms, when stone would be in excess as about fifteen to one. What he hoped to see was a trial made, which might be done at the cost of about six thousand pounds for one hundred yards in any depth, while in stone, in eight fathoms, forty thousand would have to be expended on the same length.

If Professor Airy might be admitted as a competent judge, what he had said in evidence ought to go far to satisfy Captain Sleigh, inasmuch as he affirmed that there was five hundred times less disturbance ten feet below a ten foot wave than at the surface; and twenty foot below, one thousand times less; and, if weight were due, this, he thought, settled the question, because all that was required to be found out as to Captain Sleigh's plan was the draught of water necessary to counteract the incoming swell which carried the breaker. He was of opinion that a depth of twelve or fourteen feet would be enough almost anywhere on our coasts. At the Land's End, or thereabout, and on the West Coast of Ireland, in westerly and south-westerly lasting gales, a greater depth might be necessary, which could always be given if the importance of the site justified the increase in cost.

The preponderance of opinion, instancing those of Messrs. Rendel, Coode, Calver, and other engineers and nautical men who had given evidence, went to shew that there was little or no disturbance about twelve feet below low-water mark at Plymouth, Holyhead, Portland, and elsewhere, where breakwaters had been erected, albeit there were some contradictions the other way. He was for trying anything that had been invented or projected that promised a chance of saving life, and, seeing how impossible it was to find the money for large stone barriers in the many places in which they were required, to say nothing of silting up, and constant repairs, he thought it probable that a cheaper substitute might be found to answer.

He dwelt largely on the wave-screen of Mr. Calver, and eulogised his pamphlet, but, while disagreeing with him in condemning every kind of breakwater, fixed or floating, except his own, he (Captain Claxton) would be glad to see that also tried. He had in a way tried it himself successfully in protecting the "Great Britain" in Dundrum Bay, a drawing of which he produced.

He next went into the objections which had been advanced against floating barriers; their cost; the wear and tear; the doubt as to anchors and moorings holding; the improbability of their resisting the attacks of seas and breakers, and the great probability of their breaking adrift and carrying with them the vessels under their shelter. As to moorings, he said that nautical men must discard every idea as to any similarity between the mooring or anchoring of ships, and these contrivances. The hawse-holes of ships were many feet above water, varying from seven or eight to fourteen or fifteen, according to the ship being light or loaded, whereas, in

Captain Sleigh's craft the hawse-holes were ten, twelve, or fourteen feet under water, at the very bottom of the stage. The friction, unlike that of the chains of the ship, which was great from the plunging into or rising over the seas like Light Vessels, or Trinity buoys, which were always chafing, would be here little, or he believed nothing; in Sleigh's there might (and even that he doubted) be a slight tightening and slacking of the belly or bight of the chains, and that he thought would be all. Supposing the mooring-chains to be equal to a ten-cwt. anchor, or one inch, the anchors might be equal to two and a half inch chain, and, in fair holding ground, could never start, or they might be backed in doubtful ground.

The attacks of the seas would, he thought, be trifling on the smooth inclined plane. There might be times when it might rush up the whole width, and possibly plump into the haven, and what then? Just nothing! froth and nothing else—no disturbance. As to their breaking adrift, he pronounced it next to impossible. Each section of 200 feet having four anchors to seaward, and each section attached to its neighbour, and if a vessel rushed upon one and smashed it up, it need not come under the lee, except in splinters. He thought there was infinitely more risk from one vessel driving in Yarmouth Roads, or the Downs, on those to leeward of hem.

Then, from one of these sections of the breakwater, three lighthouses, he said, would be on each series, one at each entrance, and one part most seaward. He thought the whole barrier might be considered as sacred as lighthouses were considered by nations even in war time. They would save the lives even of enemies in extremes. With regard to cost, the interest alone of the money expended on such breakwaters as Plymouth, combined with the annual outlay to keep it in repair, would renew moorings, anchors, and a whole set of Sleigh's sections, of similar extent, if found necessary, every three or four years. But he was prepared to show that, with proper attention, creosoted timber, and careful repairs in the summer, they might be made to last longer than the oldest ships—from half a century to a whole one. And, as to the moorings, where there was no friction, there would be no wear, or comparatively little, and forty or fifty years with summer overhauling, taking up and varnishing, might be their duration. Their actual cost being about a fifth or sixth of the whole.

All he wanted was a trial—an experiment—and he thought, now that we had lost the rearing of apprentices, we could not be too chary of the lives of our seamen, and most particularly as all foreigners, to the cost of the British shipowner, were encouraged, and a preference given to sailors of all nations over those of our own.

Captain Sleigh then explained the principle by a reference to a large number of drawings and diagrams, which were used for the occasion, and stated that at that moment he was engaged in preparing plans for laying down a series at Hastings.

Vice-Admiral Tayler, C.B., then said, that, as the paramount object of the meeting was to call forth the opinions of nautical men, he would confine himself entirely to practical data, which had already proved that floating breakwaters are capable of being securely moored. He had devoted more than forty years' attention to breakwaters, and was perfectly acquainted with the principle of the one in question. He had been successful himself

in establishing one at La Ciotat in France during the time of Louis Philippe. Fourteen sections were placed down off a pier that had been injured by the violent breakers upon that coast. After the sections were down four years, the French Government ordered a report on them to be made, and several of their scientific men attended, M. Arago, Admiral Dupré, Minister of Marine, and Marshal Soult among the number. The breakwater was so fully approved, that an order was given for forming one at Havre, a mile and a half in length. A chart was prepared for the purpose just previous to the Revolution of 1848. There was a fine manufactory of steam boats and steam engines at La Ciotat belonging to Mr. Mackenzie, and when the Revolution took place the mob burned it down, and they afterwards went and broke off the heads of the breakwater, and added it to the flames. Admiral Tayler lost £3,000 by the affair. However, Marshal Soult said he had no doubt the breakwater would perfectly succeed, and asked, in the event of war, what would become of them? Admiral Tayler replied, "that an international law might be passed, and that they might be made inviolable, like lighthouses."

ADMIRAL TAYLER then said that, without taking up much time, he would come to the practical part of this subject. Theory was of very little use in everything connected with the sea. All knew that the British Navy gained everything by practice, and nothing else. The origin of floating breakwaters was due to a French general, who invented one previous to Plymouth breakwater, and, by permission of the French government, tried every experiment with it and failed; and failed for a very simple cause. It was simply a breakwater with a base of from 40 to 200 feet. It was on an incline plane like a beach, and he found that as long as the breakwaters remained in a horizontal position, not rising and falling with the undulations of the waves, the water ran up them, that was when the wind and wave were in a direct line; but that when the wind set upon them in an opposite direction, acting as a kind of lever, and the sea ran up the slope, it naturally slewed them about in such a manner that no woodwork could stand it. The project was consequently abandoned. Afterwards Mr. White laid out a large sum of money in making another at Dover. He brought his six feet under water, and he thought that would be quite sufficient. The breakwater was put together; but, in a gale of wind, he found that, as a great number of the sections were in the hollow of the sea, the water came up them, and that the pressure was equal to 8,000 tons on a section, besides the moorings; and as the water rose to the top, it tore the woodwork to pieces. He could not moor it, for the sea got underneath it, and hove it all up with the anchor out of the ground. He therefore abandoned it.

It would give him (Admiral Tayler) great pleasure if anything could be devised to dispense with the enormous cost of stone breakwaters. A Royal Commission had been appointed to inquire into the question, and Mr. Calver, who was opposed to all kinds of breakwaters, was appointed secretary. He adopted his patent for inshore breakwaters, which had the effect to set aside all others. But he was sorry to see that Mr. Calver had condemned *in toto* floating breakwaters. But if all floating breakwaters had failed, what right had we to imagine that his theoretical wave-screen would succeed?

ADMIRAL TAYLER then explained his breakwater that was laid down

in France. It was somewhat in the form of a double prism, and consisted of a network of massive timbers, securely fastened together. It was launched broadside on, and towed out in that manner, and the moorings went through the keel. It was intended to resist breakers. The body of the breakwater was open, and full of inert water; and, this water being inert, of course the water to leeward was quiescent. Consequently, when the sea broke upon it, there was a solid body of water to break upon, the same as a wall. The breakers could not press it down, because the water had to pass through the interstices, and, as the moorings which passed through the keel acted as ballast, it always rose to the perpendicular, and no ship passing over it could destroy it.

He then explained that if a smooth basin was wanted, he could form an artificial bar of earth and stone, and fill it up with rubble. He brought that up to five feet of low-water mark, and filled it up with sand. He proposed to put an iron barrier upon this sand bar. He could form a harbour at Dover on his principle, with a pier for Armstrong guns, in three years, for 300,000*l.* whereas the present harbour of refuge would probably cost the country 5,000,000*l.*

In answer to a question from the CHAIRMAN—What was the depth of water at La Ciotat, where his moorings were laid down?

ADMIRAL TAYLER said that it was about 45 feet.

In answer to a question from CAPTAIN ADDERLEY SLEIGH—What became of his breakwater at Brighton?

ADMIRAL TAYLER said it was broken up, but not broken up by the sea. He received a letter from the Admiralty to go and lay down his moorings, but the Admiralty could not let him have a steamer for the purpose at that season of the year, nor even a boat. He had to get a billy-boy boat, and take it down to Shoreham. He took out the chains one at a time, laid them down, buoyed them, and fixed them; but when he came to lay down one of them he could not find the buoy—it had been cut by some small vessel. He got a small anchor, and a government chain, and moored it with them. It rode a winter and a half with that small chain, then the chain gave way; and such was the strength of the breakwater, that it came back on the other and rode out the gale, and was very little damaged. He put it on the beach, and there it remained, proving to the most sceptical its strength, adaptation, and durability.

CAPTAIN CLAXTON said that Admiral Tayler had alluded to a breakwater like Captain Sleigh's, which the sea rolled under and lifted up; but he said that it only drew six feet of water. They took theirs down twelve feet, which made all the difference. Their architect said the breakwater would be so strong that no sea would ever destroy it. It had a double deck diagonally placed, and caulked like a ship's deck, and could be made as strong as necessary. They had seen the President of the Board of Trade upon the question whether dues for breakwaters could be levied, because the Company would not go on until there was a power to levy toll on vessels using the shelter. They intended to put one up at Hastings, to prove whether it would do or not.

In conclusion, the CHAIRMAN thanked Captain Claxton, Captain Sleigh, and Admiral Tayler, for the clear statements they had given of their respective plans.

Evening Meeting.

April 30, 1860.

Colonel the Hon. JAMES LINDSAY, M.P., in the Chair.

NAMES of MEMBERS who have joined the INSTITUTION since April 16th.

Nott, A. H., Capt. Indian Navy
Miller, W. V., Paymaster Royal Navy
Hamilton, Sir E. A. Bart., Lieut. Cold. Gds.
Chelmsford, Lord, late Royal Navy
Blyth, W. D'Urban, Capt. 14th Light Drags.
Campbell, R. M., Capt. Roy. Elthorne L. I. Mil.

ON A NEW PRINCIPLE FOR THE PROTECTION OF RIFLEMEN.

By Francis Galton, Esq., F.R.S. &c.

A and B (fig. 1) are two combatants, armed with similar rifles or muskets, and firing at one another, over parapets not less than 100 yards apart. I propose to show that a screen may be interposed by one of them, A, that shall not affect the view which either party has of the other; that shall in no way prejudice A's power of hitting B; but which shall make it wholly impossible for B to hit A (by direct fire).

It is well known that the course of a projectile does not lie in symmetrical curve, but that its *descent* is more rapid than its *ascent;* in fact, at average ranges, in the case of the Enfield rifle, it is nearly one-half more rapid; and in the case of a common musket ball, the ratio is still larger. Consequently, the trajectories of A's and B's shots, fired at the exaggerated elevation represented in fig. 1, and having a range A B, would follow pretty nearly the curves there represented; whereby it is clear, that a ball-proof bridge, W, would have the effect asserted to be possible. A's bullet would pass out under the bridge, but B's bullet would strike against the bridge.

In short, I wish to point out the advantage of firing at an enemy under horizontal bridges, placed some yards in advance.

We will proceed by examining into the precise facts of the case—into the actual angles of ascent and of descent of the Enfield bullets, at different ranges, and will thence deduce the precise amount of effective cover which the arrangement I propose might be made to afford.

I have compared with care such data as I could obtain upon the trajectory of the Enfield rifle, and believe the following tables will be found substantially correct.

In fig. 1—

A *h* B is the line of sight between A and B.

A *b* is the first part of the course of A's bullet, towards B.

a A is the last part of the course of B's bullet, towards A.

b d is the last part of the course of a bullet from B, so fired as just to skim the under surface of W.

Then no bullet fired by B, which passes under W, can possibly hit K higher than *d*.

In cases such as those with which we have to deal, A *a*, *b* A, and *b d*, may all be considered as straight lines, and not as parts of curves; and *a b* may be considered as equal to the distance between *d* and the top of the parapet K.

In computing the following table, A *h* has been taken = 1000 inches, that is, about 28 yards.

Yards Range.	Angle of Ascent.	Angle of Descent.	A *h* = 1000 inches = about 28 yards.		
			b h, inches.	*a h*, inches.	*a b*, inches.
	° ′	° ′			
0	0 0	0 0	0·0	0·0	0·0
100	0 12	0 22	3·5	6·4	2·9
200	0 24	0 42	7·0	12·4	5·4
300	0 38	1 7	11·0	19·4	8·4
400	0 54	1 33	15·7	27·6	11·9
500	1 13	2 8	21·2	37·4	16·2
600	1 32	2 41	26·8	47·5	20·7
700	1 55	3 25	33·4	59·0	25·6
800	2 22	4 10	41·3	73·0	31·7

It is upon the existence and the amount of *a b* that the protection, which W can afford, depends. I will now explain what appears to me as the simplest method by which a rifleman may avail himself of it.

I trust it will be distinctly understood that I do not venture to propose any particular description of shield; but that I confine myself to enforcing a principle, leaving its application to others. I am the more inclined to do so, as persons better informed than myself have suggested that extemporaneous contrivances would be, probably, the most feasible. A man crouching on the ground might fire below a gabion, or some equivalent for a gabion, laid crosswise upon two others and placed twenty or thirty yards in advance of him. There are cases where he might avail himself of the cover of actual bridges, or where, when sheltered in a building, he could stand far away from one of the windows, and so select his position that his bullet should skim below its topmost edge. Yet, while I do not pretend to advocate any regularly constructed piece of mechanism, I feel it will enable me to convey my meaning more precisely if I describe, as I will now do, some one arrangement that would undoubtedly give protec-

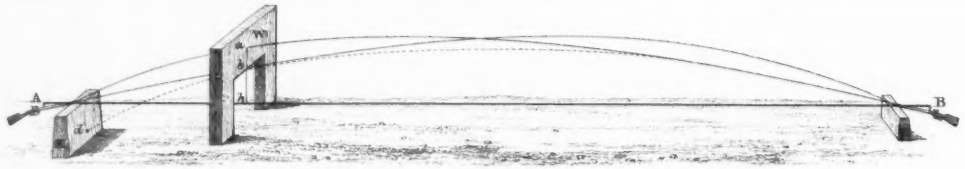


Fig. 1.

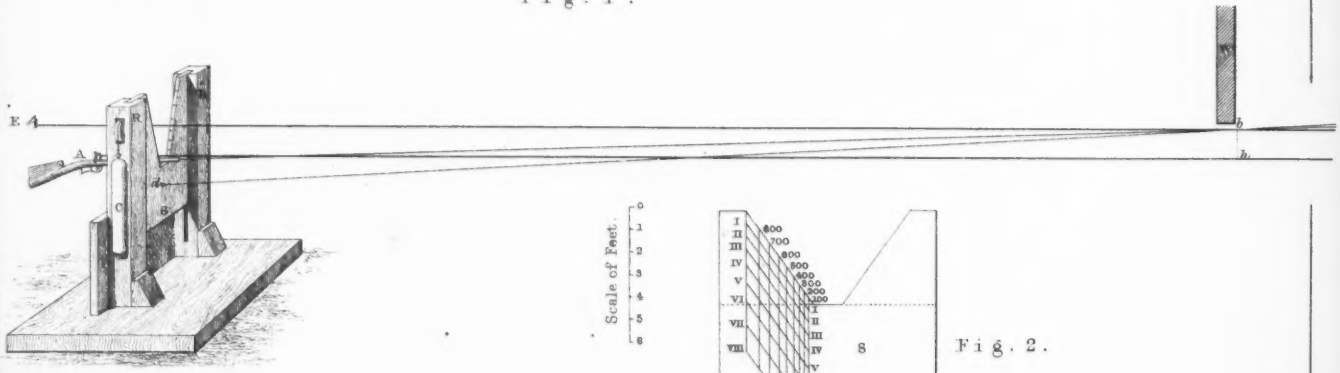


Fig. 3.

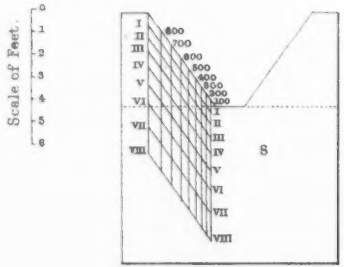


Fig. 2.

J.R.Jobbins.

tion, and would also be well calculated for purposes of experiment on the truth of my figures.*

Figs. 2 and 3 represent a solid wooden "sash," S (like a window-sash), covered in front with wrought-iron plates of not less than one-eighth of an inch in thickness. It slides up and down between two supports, R, R, and is balanced by counterpoises, (one of which, C, is seen in fig. 3,) precisely as a common window-sash. This machine is placed 28 yards behind W, and the rifleman, A, stations himself behind the sash. He is supposed to fire, resting his weapon upon S, at the level of the dotted line (fig. 2), and the machine takes the part of K in fig. 1. The figures 800, 700, &c. standing for yards, will be observed upon the sloping edge of S (fig. 2). They are written *outside* of the sash, because the smallness of the figure made it impossible to insert them legibly upon it.

The object of them is to instruct A as to the elevation he may give to his sash, without obstruction to the egress of his own bullet, under W. The heights of the points to which these figures refer, above the dotted line in fig. 2, are taken from the entries in column *b h*, corresponding to 800, 700, &c. yards' range.

We will suppose that A wishes to fire at B with the sight of his rifle adjusted to 550 yards. He will elevate his sash until the line of sight that joins B and the under edge of W shall cut the sloping edge of the sash, half-way between the divisions 500 and 600.

But, as on the one hand a much lower elevation of the sash than this would suffice for A's security, so, on the other hand, if this extreme elevation of 550 be adopted, A will be secure, not only against B's fire, but also against that of as many other riflemen as the nature of the "bridge" principle permits. The limits of A's security are shown by the oblique lines I I, II II, &c. (fig. 2). They are all drawn parallel to the sloping edge of S and at *vertical* distances below it, corresponding to the entries in column *a h*. They are to be used as follows:—Suppose the sash has been elevated to 500; then B's bullet, fired from 500 yards and skimming the under edge of W, will hit the sash *level* with the point where the oblique line V V cuts the vertical line drawn downwards from 500. It will be seen, on reference to fig. 2, that this level is considerably below the horizontal dotted line (which is the limit of A's security). Similarly, the intersection of IV IV with the same vertical line gives a safe level; in other words, a rifleman at 400 yards cannot hit A when the sash of the latter is adjusted to 500 yards. At III III A's danger has commenced: riflemen at 300 yards, and on the same plane as A and B, can hit him.

There is still another case. Suppose A has made his adjustment for firing at B, when he observes a rifleman, C, on a different plane to that on which B and himself are standing: what is his security against C's fire? In answer to this, he has simply to consult the oblique lines, on precisely the same principle as that already explained. He must ascertain the point at which a line of sight, passing from C and skimming the under edge of W, will cut the sloping edge of his sash. Then, if a ver-

* I should be glad to learn whether a bullet suffers deflection from passing *very* near to an obstacle, like W; and, if so, at what distance from the obstacle its influence is felt.—F. G.

tical line, drawn downwards from that point, cuts the oblique line corresponding to the distance between C and himself *below* the dotted line, he is safe; otherwise, he is not.

Strictly speaking, in protracting these various measurements on fig. 2, allowance would have to be made for the diameter of the bullet.

If the reader will take the pains to fix a piece of paper, ruled like fig. 2, but drawn to a natural scale, against the upper sash of one of his own windows, and experimentalize on taking sights, he will find the practical application of the figure to be exceedingly simple, far more so than it would, probably, appear from the above tedious description.

Protection may be obtained at varying ranges, not only by adjusting the elevation of a sash, but equally well by adjusting that of the bridge, the sash remaining stationary; or by varying the horizontal distance between the sash and the bridge. I do not, as I have already said, propose to enter into practical illustrations of how these manœuvres may be conveniently effected; my object is simply to indicate a principle.

The way in which I have thus far put the case, does not wholly exhaust the merits of the "bridge" principle, especially when firing at short distances. I have hitherto proceeded on the supposition that A's rifle is aimed directly at B's rifle, and this would be pretty nearly the case if B were crouching in a rifle-pit or kneeling behind an embankment, exposing little more than his head to the fire of A. But if B be a soldier in the open field, that part of his person which is below the level of his rifle, when laid to his shoulder, exposes fully twelve times as large an area to the fire of A, as that part which is above it. Supposing B to kneel, the proportion will be about as 9 to 1. Consequently A need not aim at B's rifle at all. Especially at close quarters, he may elevate his sash so high as to prevent him from even seeing B's rifle, and may direct his fire at the level of B's belt, or even lower, while B would be wholly unable to see any part of A, much less to reach him with the direct fire of his bullets.

The principle of the "bridge" is just as true for cannon as for rifles; but it is another question, which I understand must be answered negatively, whether it would be possible, in practice, to construct and use such massive screens as would be required to withstand the battery of artillery.

Lastly, this principle is likely to be of greater relative advantage to us than to others, because our soldiers are the best armed of any nation; therefore their bullets have the flatter trajectories, and the value of $a\,b$ is consequently increased to their advantage and decreased to the disadvantage of their opponents. If the assailants' bullets had flatter trajectories than our own, $a\,b$ would be decreased, and might be reduced to 0, or even to a negative quantity, in which cases the bridge would be of no protection at all.

Evening Meeting.

Monday, June 4th, 1860.

Colonel P. G. YORKE, F.R.S., in the Chair.

The Chairman announced that six Annual Subscribers had joined the Institution since the last Evening Meeting.

Nepean, Wm. Major-General	Ommanney, Octavius, Capt. Surrey Rifle Volrs.
Rodd, John R. Comr. R.N.	Close, F. A. Comr. R.N.
White, W.A. Asst. Surg. 47th Regt.	Bunn, Richd. Lieut. 37th Regt.

RIFLED ORDNANCE.

By Captain T. A. Blakely, H.P.R.A., M.R.I.A., &c.

Rifled barrels were in use more than two centuries before Mr. Robins explained the cause of their throwing bullets more accurately than smooth bores; and nearly another century elapsed before elongated projectiles were introduced, although that extraordinary man clearly pointed out the advantages to be derived from them. Progress has lately been more rapid: only thirty years elapsed between Captain Norton's first successful experiments, and the adoption in this country of his system of firing elongated bullets so constructed as to enter the barrel easily, and to expand on the ignition of the powder so as to fill the grooves of a rifle. Mr. Robins suggested elongated bullets; Captain Norton first overcame those difficulties in their use which had prevented Mr. Robins from putting into practice his own views. Hundreds, I may say thousands, have improved this system in detail; no one has yet succeeded in altering it in any material feature. The names of Robins and Norton will therefore, I venture to predict, be recorded in history long after the discoverers of the best proportions of tallow and wax for lubricating wads, and the rival advocates of male and female screw breech-plugs, have been forgotten.

The chief points on which difference of opinion still exists, are—

1st. The best method of avoiding windage, without making the loading difficult.

2nd. The proper proportion between length and thickness of projectile.

3rd. The amount of rotation necessary to keep the axis of the bullet in the desired direction.

4th. The best manner of giving the rotation.

1. The most generally-used contrivance to avoid windage is to make the leaden bullet hollow at the back, so that the gas of the burning powder shall force the edges of the lead against the inside of the rifle-barrel. It has, however, been found, that if the bullet is long the hollow is quite unnecessary, the inertia of the front of the bullet being sufficient to force

the middle and hind parts to bulge out to the size of the barrel. Mr. Ingram, the well-known gunmaker of Glasgow (the first manufacturer in this country of steel barrels), tells me that, so far from hollowing the rear-end of his bullets, he prefers to taper them when long; and the Swiss, we know, do the same. General Jacob, Mr. Whitworth, and others, make bullets almost to fit the barrel, and by so doing are enabled to use a harder material than lead. Others again have returned to the old method of inserting the bullet at the breech-end of the rifle, which they make wider than the rest of the barrel.

Practically, none of these systems seem to have any decided advantage over the others—for small arms. The direction in which we must look for improvement is in simplification of breech-loading apparatus, or in slight alteration in the form of bullets, to permit them to enter the barrel more easily, yet to yield to the first pressure of the powder and fill the bore.

2. The length of a bullet must be determined by a consideration of the purpose to which it is to be applied. The longer and narrower a bullet is, the less will be its surface exposed to the resistance of the air; the less, consequently, the diminution of its velocity. On the other hand, it must be remembered, that the pressure of the gas of the powder acts on an equally small surface, so that initial velocity is sacrificed.

Conclusive experiments have not yet been made to ascertain the initial velocities of bullets from small-arms; but we know that the long Armstrong projectile from cannon leaves the piece with a velocity of only 1080 feet per second, and a common round iron shot with about double as much. Weighing then the facility of keeping velocity and the difficulty of acquiring it, both of which increase *pari passu* as the bullet is elongated, it will be found that, to attain any given range with a maximum of facility, the bullet must be of a particular shape. From the nature of the problem, it is clearly impossible that the best length for a bullet to range 2,000 yards can be also the best for a range of 200 yards. For the former we require a long bullet, leaving the rifle slowly, but keeping its velocity almost undiminished; for the latter we want a short bullet, to traverse the space quickly.

In deciding on the choice of a military weapon, many points must be carefully weighed. Shall the whole army have but one kind of weapon? If so, shall we sacrifice long range to efficiency at moderate range, or shall we purchase the chance of killing a general's horse a mile off at the price of ten or even five per cent. of our effective fire at close quarters? Shall we have two, or even three, kinds of rifle? These questions are yet unanswered, and, I trust, will be fully discussed this evening. My own opinion is, I confess, not the popular one. I incline to that weapon whose best shooting is at 200 yards—the Enfield rifle, or, better still, the Swiss, which fires a lighter bullet.

3. As rotation in one direction is given to the projectile to counterbalance forces tending to make it turn in another, it follows that the longer the bullet, and, consequently, the greater the leverage of the latter forces, the greater must be the correcting force. It will not, however, be enough to increase the twist in proportion to the disturbing forces, it must also be increased in the inverse ratio of the diameter of

bullets of like length, to produce the same amount of rotary momentum. The particles at the circumference of a bullet one inch in diameter, rotating 100 times in a second, have only exactly the same velocity as those of one-half the diameter and rotating twice as often. So evident is this, that I believe no difference of opinion exists as to the rule that the more elongated the projectile the greater must be the twist.

Many experiments have been made, with a view to determine the exact length of bullet each degree of twist can steady. Amongst others, I may mention those of Mr. Dove, of Glasgow, who had a set of steel barrels rifled, of precisely the same length, weight, diameter of bore, and shape of groove; the only difference being in degree of twist. He found that, with one turn in 50 diameters, he could fire a bullet three-and-a-quarter diameters in length; with one turn in 60 diameters he could use a bullet $2\frac{3}{8}$ diameters in length, with one turn in 75 calibres the bullet might be a little more than $1\frac{3}{4}$ diameters in length.

The Swiss Government about the same time made similar experiments, and determined on the use of a military rifle, $\frac{41}{100}$ inch in bore, throwing a bullet 2·44 calibres long, with only one turn in 80 calibres. The apparent discrepancy of these results is explained by the very great charge of gunpowder used by the Swiss. Their bullets weighing less than half as much as the Enfield or Mr. Whitworth's bullets, a man can use a charge of powder which would disable him if he attempted to use it with a heavier bullet; he consequently obtains much greater initial velocity.

General Jacob made, perhaps, the most extensive series of experiments ever undertaken by an individual. He found that a bullet $2\frac{1}{2}$ calibres in length could be kept point foremost by firing it from a barrel with a twist of one in 57 calibres, even when the point was lighter than the base. While General Jacob and Mr. Dove were making experiments at their own expense, Mr. Whitworth was making some at that of the country. As he has taken out patents for any improvements he has made, they can be accurately ascertained from his published specifications, so I need only briefly refer to them. The bullet he wishes to introduce into the military service of this country is 3 calibres in length, and weighs 520 grains. With 80 grains of powder he can project this bullet from a rifle-barrel, having one turn in 46 diameters, to a distance of upwards of a mile with astonishing accuracy. The initial velocity is, however, not great, and the rifle is very expensive, depending for its accuracy on workmanship only, not on the development of any new principle. We may fairly consider it proved by General Jacob, by Mr. Dove, and by Mr. Whitworth, that with a moderate initial velocity of bullet, one turn in 45 or 50 calibres is ample to give rotation to the longest rifle bullet required. We may also accept the theory acted on by the Swiss, viz. that with greater initial velocity less turn will suffice, and the converse as proved by the Sardinians, who use a small charge of gunpowder, but the extremely short twist of one turn in 26 calibres. All the bullets I have referred to were solid, and some tapering at both ends. When the base is hollowed, and the centre of gravity thrown forward, the bullet is under different conditions, which we shall scarcely have time to discuss to-night. Suffice it to say, that less force must evidently suffice to keep the weight

in front than elsewhere, that being the position it would seek. Captain Tamisier, a French officer, found also that circular grooves cut round the base of bullets steady their flight, by acting the part of the feathers of an arrow. He succeeded in throwing bullets, 7 diameters in length, yet point foremost. This is one of the most valuable improvements in bullets.

4. To give the necessary rotation to the bullet, grooves are, we all know, cut spirally round the inside of the rifle barrel. Some recommend shallow grooves, some deep ones; some oblong, some triangular; some recommend sharp angles, some wish the angles cut away; and, strange to say, all methods seem to answer the purpose very nearly equally well with small-arms. I will therefore reserve the discussion of this point till I come to consider the case of large guns, in which the nature of rifling will be found much more important.

Besides the main points to which I have referred, much might be said on the best method of keeping a barrel clean, on the best material of which to make it, and on many other more or less important questions, all, like the foregoing, eqally applicable to rifled small-arms and rifled cannon. I must, however, hasten to the more especial consideration of the latter.

It must have struck every one as strange that, all the conditions of success being known for rifled small-arms, cannon should not earlier have been rifled.

The reason is not obvious why large bullets from large rifles should not give results proportionate to those obtained from small bullets and small rifles. Colonel Cavalli, the able superintendent of the Sardinian cannon factory, was one of the first who grappled with the difficulty. He found, however, that if he used more than a very moderate charge of gunpowder, his cannon burst. Mr. Lancaster's experience might be stated in the same words.

In 1854 Mr. Bashley Britten made a most valuable invention. He contrived to solder a leaden ring to an iron shell so firmly that they do not separate when fired. Very many attempts had been made to surround the whole or part of iron-shot with lead, but, before Mr. Britten, none ever succeeded in making the lead adhere.

He has been engaged in a series of experiments for some years, firing his compound shells from rifled cast-iron cannon. He finds, however, that his success is limited by the certainty that the guns will burst (one has done so) if he uses a full charge of gunpowder.

In 1856 Mr. Joseph Whitworth rifled a cannon on the model of one of his successful small-arms. To a bore of only $4\frac{1}{2}$ inches, he left a thickness of 9 inches of metal all round; yet this cannon burst almost immediately. He then tried one with sides still thicker, but it too burst—at the sixth round.*

In 1855 Mr. John Lawrence had a 95-cwt. gun rifled almost exactly like an Enfield rifle, and fired from it 80-pound shots, obtaining a range of 2,600 yards, with five degrees of elevation, as yet the lowest trajectory but one. The gun burst after a few rounds. I might enumerate dozens of attempts made to produce efficient rifled cannon, each with all the elements of success, except one. Windage was prevented in Mr. Britten's and in

* See Sir Howard Douglas "On Naval Gunnery."

Fig. 1. French Gun, Pattern 1859.

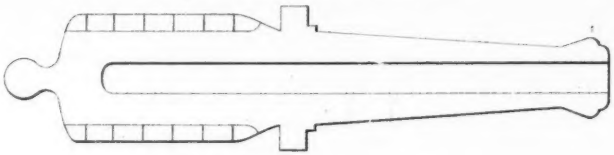


Fig. 2. Armstrong Field Gun, Pattern 1859.

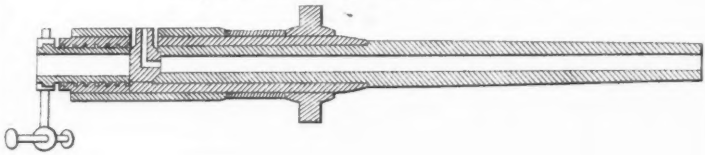


Fig. 3. Cavalli Gun, 1859.

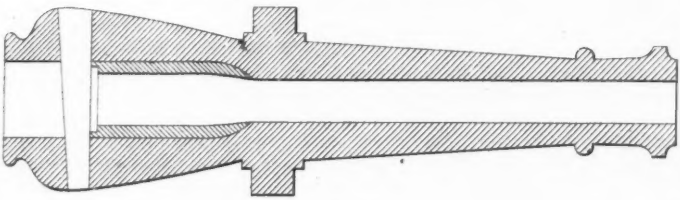


Fig. 4. 70 Pound Armstrong, 1860.

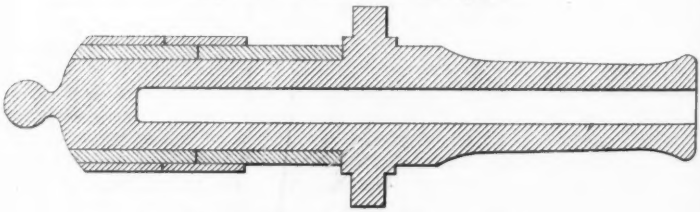
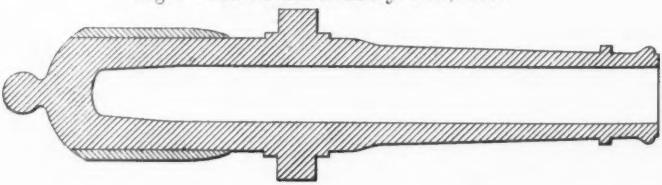


Fig. 5. 132 Pound Blakely Gun, 1857.



Mr. Lawrence's muzzle-loading guns by the expansion of lead; in Mr. Whitworth's by the mechanical fit of the projectile. The amount of rotation adopted by Cavalli and Wahrendorff was precisely the same as that now advocated by Mr. Whitworth. Their system of breech-loading was at least as simple as his, or Sir William Armstrong's. As I said before, only *one* thing was wanting, and that was *strength* of barrel.

Now that we know how to make barrels strong enough, we are apt to forget our embarrassment a few years back—the intense disappointment with which we received the news of the bursting of Mr. Nasmyth's wrought-iron gun, followed by that of Mr. Walker's—the avidity with which Nova Scotia iron was bought up as being stronger for gun-founding—the hundreds of thousands we spent at Woolwich to discover a better method of casting iron—the cold water thrown during two consecutive years by the British Association on all proposals to build up guns—the trial of cast steel at £300 a ton—all this we are disposed to forget.

I should, however, be most ungrateful to this Institution if I allowed to be forgotten its instrumentality in diffusing the knowledge of those simple means for obtaining great strength in cannon which were first adopted immediately on their publication in our Journal, and are now almost universally used. In France, in Sardinia, and in Spain; last year in this country, and now, I am told, in Russia and in Holland, the views promulgated by this Institution have been adopted. I am vain enough to believe that experiments conducted by myself had much effect in convincing people; but, had the results of those experiments not been published by this Institution, the effect would have been lost.

The method of making cannon to which I refer is probably familiar to you all. Cannon are now made of concentric tubes, each tube compressing that within it, so that the whole thickness must take share in the strain produced by firing. I need not remind you that in any thick tube made in one piece, whether of cast iron, or wrought iron, or steel, or brass, the inside is liable to be fractured before much strain is communicated to the outside, and that it is to remedy this defect that the initial tension of the outer parts was proposed.*

I have prepared sketches of the principal cannons to which this system of manufacture has been applied. First in point of date (after the experimental cannons made by Mr. Longridge and by myself†), is the French rifled cannon (fig. 1).

It is made only in two layers, the inner of cast-iron and in one piece, the outer one of wrought iron and in seven pieces.

Fig. 2 is a section of the celebrated Armstrong gun adopted in 1859. The inner layer is made by twisting bars of iron into coils, welding each coil into a short cylinder, and then welding these cylinders together, end to end. The next layer is made by welding together lengthways two long slabs, semi-cylindrical in section; the third layer is made of coils like the first, but these are not welded to each other. I should observe, that Sir William Armstrong disclaims most distinctly any desire to obtain strength

* See Journal of United Service Institution, Vol. ii., page 304, Blakely "On a Mode of constructing Cannon," and Vol. iii., page 1, Blakely "On some Experiments elucidating his theory of manufacturing Cannon."

† See former papers as above.

by adjusting the size of the different layers. If they do happen to be correctly proportioned he wishes it to be known that the circumstance is accidental, and that he learnt nothing from my writings.

Last year Mr. Whitworth, taught by his previous failures, and rightly attributing the success of the Armstrong gun to its strength, himself adopted the same principle of construction for his 80-pounder gun. This he made of a tube of what he calls homogeneous iron, rifled internally, and tapering slightly outside. On this conical tube he forced short tubes of wrought iron, and over these a third layer of tubes.

Fig. 3 shows a section of the gun lately introduced by Colonel Cavalli into the Sardinian service. It is nearly all of cast iron, but at the breech it has a second internal layer, composed of soft brass.

Fig. 4 shows a section of the new British Naval Gun planned by Sir William Armstrong. At the breech it is in three concentric layers, but, the outer two being avowedly shrunk on without any attention to their size, the result must be very uncertain. I can say nothing more complimentary about the shape of the interior cast iron part. It suddenly increases in thickness by five inches,—a great defect in a simple casting, much greater in one destined to be partly enveloped by a strong wrought-iron jacket. When the gun is fired the thinner part is strongly compressed and the thick part stretched. Bearing this in mind you will, I am sure, share in my astonishment, when I say that one of these cannons has absolutely been fired 63 times with proof-charge.

Fig. 5 is a section of a 10-inch gun which was made, in 1857, at my suggestion, in only two layers. It weighed less than the new naval gun, yet was fired—

10	rounds	with 20lbs. powder,	and a projectile of	132 pounds.
10	"	"	"	264 "
10	"	"	"	396 "
9	"	"	"	512 "

I am now making several rifled cannon for experimental purposes, and I adhere very closely to the form which has given such good results. I am not aware what consideration induced Sir William Armstrong to depart from that form. They must be very grave ones, yet I trust they will be reconsidered; for I find, by experience, that a $6\frac{3}{8}$-inch gun need not weigh more than three tons, whereas his weighs five, owing to the great thickness of the middle and front parts.*

Last year I made one weighing only 48 cwt., yet strong enough to throw 58-pound shells to a distance of 2,670 yards with five degrees of elevation.† The shells I fired were on Mr. Bashley Britten's plan, than which nothing can be more simple. Figs. 6 and 7 represent these shells in section before being fired; figs. 8 and 9 after being fired, when the leaden ring *f* has

* Mr. Herbert has since acknowledged, in answer to a question put in the House of Commons by Mr. Berkeley, that these cannon are failures. At Mr. Herbert's request I am now trying to make them useful, but I fear some of their defects are incurable. —T. A. B.

† This was then the longest recorded range with five degrees of elevation. I have, however, since obtained one of 2,720 yards, with a 68-pound shell, from a 60-cwt. gun. Mr. Lawrence's shot ranged 2,600 yards with the same elevation; Mr. Whitworth's 80-pounder, 2,550; Sir Wm. Armstrong's, 2,366, and the smooth-bored 56-pounder, 2,260.—T. A. B., *Oct. 24th*, 1860.

Fig. 6

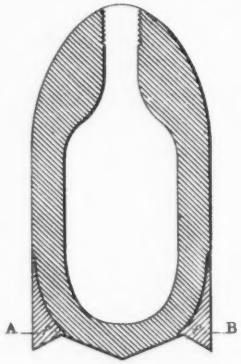


Fig. 8.

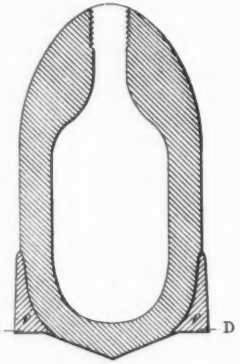
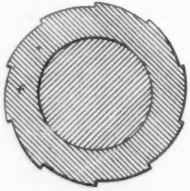


Fig. 7.

Section at A.B.

Fig. 9.



Section at C.D.

Fig. 10.

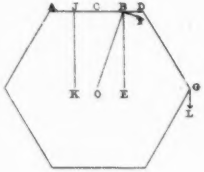


Fig. 11.

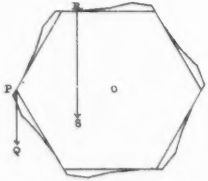


Fig. 12.

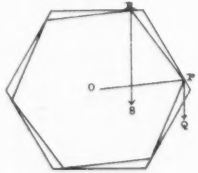


Fig. 13.

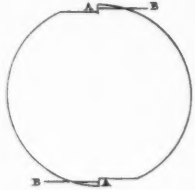


Fig. 14.

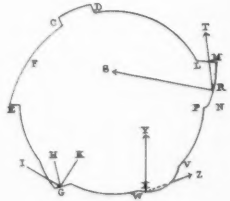


Fig. 15.

been forced into the grooves of the gun. One of my objects in making this gun was to prove the truth of what I have stated to-night, that the efficiency of large rifled cannon depends on their being built up in concentric layers to secure *strength*. When I commenced this gun it was denied that the Armstrong cannon was made on that plan, the Whitworth 80-pounder had not been heard of, and the French model was not known to the public, so I did not anticipate having such convincing proofs at command of the efficiency of the system as I have been enabled to bring before you.

The rifling of my cannon is of the very simplest possible form. The object of rifling being to turn the projectile round its axis, it stands to reason that the best plan for applying that force is at the circumference, and in a tangential direction, as at *G*, in a direction *G L*, fig. 10.

In a hexagonal bullet the force is applied in a much less powerful manner. Such a bullet must either be too small for the gun, or too large, or else fit it accurately. The latter is the condition Mr. Whitworth first attempted to secure.

It must, however, be evident that, if the whole surface of the bullet is pressed against, one-half of every side must be pressed in a direction contrary to that desired. Thus, in Fig. 10, if the shot is meant to revolve in the direction *G L*, all the pressure on the half-side *C D* will assist this motion, all on the half-side *C A* will resist it, and cause enormous friction and waste of power. I will not dwell on the difficulty of inserting an iron projectile into a gun which it fits mechanically; Mr. Whitworth found that sometimes as much as 20 minutes was required to ram the shot home. Partly in consequence of this difficulty, and partly, perhaps, from discovering that the pressure on one-half of each surface of his shot was mischievous, Mr. Whitworth, after the bursting of his second gun in 1857, abandoned his idea of a mechanical fit, and, while retaining an almost hexagonal form for his bullet, planed away that part of the bore whose pressure would be mischievous. The bore of his latest guns is 24-sided in section, six of these sides only being bearing surfaces, see fig. 11. If from *R*, the centre of one of these bearing surfaces, a line *R S* be drawn perpendicular to the surface, it will represent the force tending to make the shot rotate. A glance will show how much less force would effect the same object if applied at *P* in a parallel direction. The most favourable condition for a hexagonal projectile will be when it is too small for the gun; then it will only bear on the edges, see fig. 12, and, the force being applied further from the centre, as at *R S*, only twice as much will be required as if it were applied at *P* in the direction *P Q*. The worst of all conditions would be the mechanical fit (fig. 10), where not only part of the pressure (*J K*) would prevent the bullet from rotating, but where the force which we may suppose to act at *B*, and to be represented by *B E*, would be so disadvantageously applied that, if we resolve it into two forces *B O* and *B F*, the former, which can only cause useless friction, will be found four times as great as the latter, which alone is useful.

It may be asked, How is it that Mr. Whitworth's small-arms give such good results, seeing that the bullets, being made of lead, are in this condition which I have ventured to call the worst possible? The reply is simple: The enormous friction, which burst the two large cannon, is useful in the small rifle, by retarding the first movement of the bullet and giving the gunpowder time to burn.

Sir William Armstrong has found also that the resistance caused by his bullets being larger than the general bore of his guns is good for small ones, but fatal to the efficiency of his larger ones. With ten degrees of elevation his 80-pounder only ranges 3,900 yards with eleven pounds of powder. Mr. Britten can throw a 50-pound shell 3,700 yards from an old cast-iron 32-pounder rifled.

Precisely the same thing may be said of Mr. Lancaster's rifles and cannon.

In fig. 13 I have represented the section of a projectile for a large cannon. Any pressure on the surface *A* must act in the direction desired, *A B, and in no other.* There would consequently be no unnecessary friction. That very common form shown at *C D*, fig. 14, is nearly as good, but one of the surfaces, *C* or *D*, must be useless, and it surely simplifies the form to cut off the shoulder as at *E F*. The bearing surfaces must be truly radial. The slightest inclination causes increased friction, as at *G*, where the pressure, acting in the line *G H*, can be resolved into two forces, *G I* useful, and *G K* the reverse. The form of groove adopted by the French, *L M N P*, fig. 14, has all the disadvantages of the hexagonal bore, for the force is applied to the bullet by the surface *M N* in the direction *R S*, whereas motion is intended to be given in the direction *R T*.

All curved grooves, as at *V X W*, have the same defect: force is applied in a direction *X Y*, quite different from that *X Z*, in which it should be given.

Although two rifling surfaces would suffice, it will be better to have them more numerous and shallow when lead-coated projectiles are used—I find seven, each one-twentieth of an inch deep, answer well for 68-pounders. Mr. Ingram, the well-known gunmaker of Glasgow, has used the form of rifling Fig. 13 for fifteen years. I am told that Captain Hayes, of the Navy, has also tried it with success.

Although I have endeavoured to make such remarks to-night as will, I hope, lead to discussion as to the best form for large rifled cannon, I must record my decided opinion (and I trust a like opinion will be expressed by some persons more likely to be listened to) that we should not wait till a long series of experiments has decided the best form, but at once do what can be finished most quickly, viz. rifle many of our stock of cast-iron 32-pounders.

We need not even delay to strengthen them, for that can be done at a future period.

It is not to the honour of this country that it should be the last in Europe to arm its navy with rifled cannon.

The CHAIRMAN.—I will ask the Meeting to return thanks to Captain Blakely for the very interesting and instructive paper that he has just read. I believe I am correct in saying that, if Professor Barlow, of Woolwich, was the first to point out the cause of the weakness of guns and the reason of their failing, our friend Captain Blakely was the first, at any rate, to publish the proper principles for correcting that evil, and strengthening the guns. I do not pretend to any great authority on the subject, but I believe I am correct in saying so much.

Mr. HADDAN.—It appears to me that the first and most important question is this: has it been shown that the present service guns cannot be effectually rifled? I think this has not been proved at all. Many of the trials that have been made prove nothing—it was absolutely certain the guns would burst. As a mechanic I have no hesitation in saying that no plan of rifling cast-iron guns can possibly be worse than Mr. Whitworth's. I believe that every cast-iron gun that he has rifled has burst—not only service guns, but 68-pounder blocks made of Low Moor iron, bored only to a 32-pounder bore, and they have burst with a very small charge of powder. Does not this prove that the hexagonal bore will not stand the strain? I have maintained, and I think I can prove, that that plan of rifling which leaves the bore, after it has been rifled, the nearest possible to the cylindrical form must be the best. The next worse form for cast-iron guns that could be adopted (and I am certain that no mechanic will contradict me) is the "shunting" plan of Sir William Armstrong. He has three deep, square grooves, one groove being of a different shape to the other two. It is evident that a cast-iron gun rifled on this plan would burst; and every gun he has tried, has burst after a very few rounds indeed, not only cast service guns, but guns specially cast and strengthened with wrought iron hoops. Any gentleman who will go to Woolwich can see many of these guns with the ends blown out. That being the case, the inference has been drawn by those who do not pay much attention to the subject, that the service cast-iron guns have failed, and hence the different suggestions for hooping them. Then the question is, can the present service guns be rifled so as to be available for all useful purposes? I think they can. I was present at Woolwich when one of Walker's 68-pounder cast service guns was tested. It was fired first of all 10 rounds with 16 lbs. of powder and a 68 lb. shot, then 10 rounds with 136 lb. shot, 10 rounds with 204 lb. shot, 10 rounds with 272 lb. shot, 10 rounds with 340 lb. shot, 10 rounds with 408 lb. shot, 10 rounds with 476 lb. shot, and 5 rounds with 544 lb. shot; the whole of the charges being 16 lb. of powder, and a wad was used in every case, and it burst at the sixth round with the 544 lb. shot.

That was a common service cast-iron gun, not hooped or strengthened in any way whatever. I need hardly say that no rifled shot could ever give anything like that strain. Therefore, I cannot at present see, if the guns are rifled in a way not to ruin the gun at the beginning, why the present service guns should not answer without any hooping whatever. I use a shot very much like a skittle pin. It has a conical point and a somewhat taper back. On the end or back part of the cone I use a wad of wood. The effect of the powder is to drive the wad up on to the shot, and spread it out and make it fit the bore of the gun, and the escape of gas is prevented. As to range and deflection, much depends on the weather and other circumstances. One day Mr. Whitworth may have a fine day, and he gets the best results, and he takes care to get them published. Another day may be very windy, and the results being bad, nothing is said about them. I have heard it stated that Mr. Whitworth's shots have deflected 260 yards. It is the same with others, they pick out the shots that tell, and they say nothing about those that fail. I go down alone, and Mr. Whitworth is accompanied only by friends, and each is obliged to take for granted what the other states.

Then to come to the next point: it seems to me that the cast-iron service gun must be rifled with a very slow twist, so as to weaken the gun to the least extent. The real point is to have them rifled in a proper way; if that could be secured, then I think we should get the best results. I should wish to state one particular fact that I think will bear greatly on this question. Some little time ago I heard of Mr. Mushet, who lives at Coleford, in the Forest of Dean, and he sent me up some samples of metal, which have been tested at Woolwich, and I will read what Mr. Anderson wrote to me only last week—

"Mr. Anderson presents his compliments to Mr. Haddan, and begs to inform him that the strength of the material tested is as follows:

	Tons.	Cwt.	Qrs.	Lbs.	
1st Specimen.—	48	16	0	18	per inch.
,,	46	1	1	13	

"Royal Gun Factories, 11 May, 1860."

At the same time, Mr. Anderson gave me the results of the trial of different makes of wrought-iron which had been tested with the view of ascertaining which was the best for making the hoops for the Armstrong guns: and in no case did the wrought-iron bars stand more than 26 tons to the square inch. Now, I think, no gentleman will deem me very unreasonable in drawing the conclusion, that, if guns can be cast to bear the strain which that metal stood, it is perfectly useless to make built guns. At present I have got a few guns cast of this metal, and an application is before the War Office that one of them may be bored and tested. It is important I should state that this metal is cast and is not hammered or forged in any way, but is simply cast of the shape required. The whole secret is this, that Mr. Mushet has discovered a method of casting this peculiar metal free from honeycomb, and being free from honeycomb it does not require to be hammered to close it up. I believe guns made of this metal may be loaded to the muzzle, and cannot be burst. I will now, if you will allow me, explain my plan of rifling service guns. Theoretically, the worst plan would be to have one nick or groove, since the whole strain would be thrown on it. It would be better to have two, and three would be better still. The best plan would be to cut away as nearly as possible an equal quantity of the metal all round the bore, as the strain will then be equal. The plan I have adopted in rifling is to make three very broad shallow grooves with little or no shoulder and narrow lands, and a gun so rifled is very little weakened. Assuming that to be the case, the next question is, will a gun so rifled give the necessary rotation to the shot. The plan I have gone upon is simply this. Supposing for the sake of illustration that the bore of a gun is triangular, and that the shot is so too, but less in size, there will be no difficulty in loading. But the gun being virtually twisted by the rifling, the effect of the ball continuing in a straight line compels the three angles of the shot to bear against the three sides of the gun, and it necessarily therefore passes steadily along the gun, and with its axis in the axis of the bore, and the same effect is produced as by making the bullet expand and fill up the bore of the gun. The effect is the same in both cases, with this one great advantage in favour of my plan, that you can use a rigid bullet that does not alter its form at all, and the friction is very trifling. Of course in practice I do not make the bore triangular, but

tri-curved, and with a shot of corresponding shape, the three curved swells on the shot bearing against the three sides of the curved cuts or broad shallow grooves in the gun. I also believe that much more accurate shooting will be thus obtained than by using an expanding ball, to say nothing of the cheapness of using a cast-iron shot, and its capability of being fired red hot, or, if made hollow, of its being filled with molten iron, the "Martin" plan, which cannot be the case with any compound shot of iron and lead. There is another result which I believe is more important than all, so far as cast-iron service guns are concerned. In my mode of rifling, the wings are at the front part, and are only a short depth along the projectile. Where the shot is rifled to the base, it is quite evident that the rifling of the gun must always be carried down to the powder, while I only carry my rifling down sufficiently to take the wings of the projectile. Consequently, I have at least a length equal to one diameter of the bore above the charge of powder unrifled. Where the rifling is taken down to the charge of powder you have the explosion taking place in or close to the rifling, and that is the reason I believe why guns so rifled have burst, and why I have had no failure.

The CHAIRMAN.—Is not the metal used by Mr. Whitworth very much of the same nature?

Mr. HADDAN.—I do not know. Mr. Whitworth makes rather a mystery of his metal. He calls it homogeneous. I believe it is tilted or hammered in some way—it is not cast—I understood he paid 100*l.* a ton for it. Mr. Mushet's metal does not cost anything like that sum.

MR. ASTON.—After the statements of the gentleman who has just sat down one would have expected to have had a little more information upon the subject. He has spoken with boldness upon what Mr. Whitworth does, but the moment any question is put as to particulars he is at fault. The metal Mr. Whitworth uses he does not give 100*l.* per ton for; and the gentleman should have heard him, at the Institution of Civil Engineers, state that he gave 60*l.* a ton for it, if his memory had not failed him. Again, I have to challenge the accuracy of that gentleman's remarks with regard to the result of Mr. Whitworth's experiments. He stated that on divers occasions projectiles that have been fired by Mr. Whitworth have gone to the extent of 250 yards, either to the right or to the left of the direction of the line of fire.

MR. HADDAN.—I heard him say so myself: in a high wind. He stated so most distinctly.

MR. ASTON.—He has also stated that this class of results had not been published, whereas Mr. Whitworth stated them in public, and they were published in "The Times" newspaper. I happened myself to have been present at Southport when nearly every shot was fired, and I saw the result of every shot published in the paper. That certainly is a new feature in gunnery, that all the shots should be published, and that the public should be left to judge for themselves. But, even supposing that in high winds shots should be thrown 250 yards to the right or left of any object aimed at, if eight or ten shots are equally thrown to that distance, is it such a difficult thing for artillerymen to make allowance for the wind, and lay the gun accordingly? Surely, if projectiles, when fired, will fall one behind the other in a moderately straight line, with a very little difference between them longitudinally, the gun that will do that will, I apprehend, be consi-

dered a great gain, without considering the deviation, which must depend upon the direction in which the wind is blowing with regard to the range. Another thing the gentleman stated with regard to Mr. Whitworth's system of rifling, and I must say this, when I heard this gentleman state, that his is the worst system of rifling, and that some one else's was the next worst, I understood it would end in his declaring his own to be the best. That we can all understand; and when he asked us not to attribute to him any dogmatic conclusions, why, I leave that to be judged of by those who heard him. With regard to the material which Mr. Whitworth makes use of, it is called, as you know, homogeneous iron, and it is produced simply by taking the ordinary Swedish iron, which is brought over in order to be converted into steel, and melting it in the ordinary crucibles, rather larger, perhaps, than what are ordinarily used. If the ingot is for a large piece, a 32-pounder, or an 80-pounder, very many crucibles are required. The contents of all are run into one large ingot; that solid ingot is afterwards hammered under a tilt hammer to consolidate its fibres. It is afterwards bored out, and if it is a large gun it is strengthened with hoops. Now, with regard to the matter of strengthening with hoops, from the observations which fell from Captain Blakely in the course of his paper, you would suppose that Mr. Whitworth had, after communication with, or deriving information from him, made use of the system of hooping which that gentleman was the first to publish, and which he in point of fact communicated, either directly or indirectly, to Mr. Whitworth. That is a statement which I beg most directly to challenge; and I do so on the authority of a work, which is accessible to any gentleman, and to which, with your permission, Sir, I will refer. It is a book published by the Lords Commissioners of Patents, and is entitled, "Abridgments of Specifications relating to Firearms and other Weapons." In this little book are collected together short notes on the specifications of all letters patent that have been taken out relating to this subject. Of course the book will speak for itself. Those who have priority of invention are here recorded in the order in which they are entitled to claim it. I would beg, therefore, shortly to call your attention to a few of these specifications in which the subject of hooping cannon is treated. The first to which I will refer is one dated 1843. The name is John Frith; the title is "Improvements in the Manufacture of Cannon." Among other things he says,—

> The cannon is cast, and is strengthened by wrought iron or steel hoops, or rings, shrunk on while hot. The first reinforce is hooped with strong wrought iron or steel bands, driven on whilst hot, so that the contraction thereof, in cooling, will produce firm adhesion; thus that part of the cannon most acted upon by explosion and heat is materially strengthened.

The next one to which I refer is dated 1852. The names are John Linton, Arabin Simmons, and Thomas Walker. The title is "Improvements in the Manufacture of Ordnance." Among other things it says,—

> The piece of ordnance is made of wrought iron, forged solid. The mass of the piece of ordnance is formed by placing a number of segmental bars of rolled or hammered iron together round a cylindrical core, the segmental bars being twisted in the length of the faggot. The faggot is then welded together into a cylinder, which forms the core of a second cylinder, segmental bars being placed round the first cylinder to form the faggot, from which a second cylinder is made, the bars in the second being twisted in an opposite direction to those in the preceding faggot. The process of faggoting may be repeated until the mass arrives at the dimensions required for completing the piece of ordnance,

and affording strength adequate to resist the charges employed to propel the shot under any given condition, each set of bars being twisted round the core formed of the preceding faggot in the opposite direction to that in which the bars were twisted in that faggot.

The next to which I would refer is that of William Bridges Adams, dated Nov. 20, 1854. This was a provisional specification. Probably for the information of some of my hearers, who may not know the difference, I should state that when any person applies for letters patent, he is obliged in the first instance to deposit a document which gives an outline description of his invention. That is called a provisional specification; and it being lodged in the Patent Office entitles him for six months to provisional protection. During that time he is entitled to make such additions to his invention as will enable him to carry it out more fully, always adhering to his original plan. At the end of his six months he is obliged to deposit a complete specification. This then was a provisional specification, and Mr. Adams did not think it worth while to go on, probably for reasons known to himself. He says, "My improvement consists in forming the interior of the gun of a wrought tube, hermetically joined at one end, and of as great thickness as can conveniently be attained, and casting iron, brass, or gun-metal round it, forming as far as possible a union by means of chemical fluxes." He says further, "These tubes may be hooped round with two or more rings of wrought iron hoops, shrunk on hot, and interlocking with each other." The next to which I would call your attention is that of Mr. Whitworth himself. On the 1st of December he took out a patent for "Improvements in Cannons, Guns, and Fire-Arms." He says:

My invention consists, firstly, in constructing cannons, guns, and the barrels of fire-arms in separate parts, and uniting together, by means of hoops or belts, two or more segments made of a particular shape, which when so united form a cannon, or other piece of ordnance, or the barrel of a fire-arm, the interior of which may be rifled, not by boring and cutting grooves in it, as in the ordinary mode, but by making the interior in the form of a hollow polygonal spiral or screw of the requisite pitch and number of threads. The spiral figure adopted may have any number of sides, as may be found most suitable to the size of the piece; for an ordinary rifle I have found it advantageous to employ from six to eight sides, and for a twelve pounder cannon nine sides. Great accuracy is required in making the segments, as each should be the exact counterpart of another; the surfaces of their edges intended to be brought in contact must be perfectly true, and be so shaped that the lines of junction in every case shall follow the course of the spiral, and bisect at every point one of the angles of the hollow spiral figure formed by all the segments when united. Their exterior surfaces may correspond in shape to their interior, or may be circular, so as to form when hooped together a conical surface tapering from the breech to the muzzle. The inner surfaces of the hoops or belts for uniting the segments will correspond with the outer surface of the segments on which they are fitted. The said hoops or belts may be made of any required breadth, the most economical, and may be forced on the segments so as to produce the requisite degree of tightness by a screw at the muzzle.

He also says,

A second series of belts may be used outside the others for giving additional strength.

Well, then, I say, that being so, Mr. Whitworth cannot in fairness be charged with pirating an invention which any other gentleman has patented, when the patent which he is alleged to have infringed and to have pirated from is one which is dated in the year following. If it is stated that Mr. Whitworth by using that invention infringes upon a patent of the date of 1855, it is quite clear that the patent of 1855 must be invalid, inasmuch as it contains that which Mr. Whitworth works upon under a patent of 1854. I should not at this great length have alluded to these particular instances,

had it not been that it is a subject which has attracted a great deal of notice, and upon which most of us would be glad to have information upon which we can rely. Therefore, if what I have stated appears to bear the impression of anything like partisanship, I avow that I am an intimate friend of Mr. Whitworth, and therefore am fully acquainted with all that he has done. At the same time, by referring to the authorities I have quoted, you will be able to ascertain whether I have advanced more than I have been warranted in doing.

Mr. LONGRIDGE.—Perhaps I may be allowed to make two or three remarks upon this subject. In the first place, I must express my great regret that Mr. Whitworth's friend has thought it necessary to convert this meeting into a court of law to determine the question of priority of claims. He has referred to specifications, which, as a scientific man, I have no hesitation in saying have nothing whatever to do with the question under consideration, and which, indeed, must yield in priority to Mons Meg, and a great many other hooped guns in India. The question of priority is an unimportant question; but, as it has been mooted, I think it due to Captain Blakely to point out in what the essence of his plan consists. It is not at all in hooping guns, but it is in putting those guns together with such a degree of initial tension on the outer parts that the inner core shall be put into a state of compression. With respect to Mr. Whitworth's patent, I know that patent intimately, and I know Mr. Whitworth intimately, and he showed me himself the gun which he was making in 1855. It was in three segments; I pointed out to him then that that gun in no degree clashed with what myself and Captain Blakely were doing. The only good point about that gun was that so long as the joints between the radial segments were tight, it radiated the force on to a greater surface; and so far that was an improvement. But he found out, as I told him, that those joints would not do, and *he abandoned them.* As a scientific man, I say that that patent of Mr. Whitworth does not affect Captain Blakely's gun. With respect to the question of strengthening guns, I may briefly refer to it. The system which Captain Blakely has hitherto carried out practically is that of hoops. I refer to it because I have on two or three occasions expressed a decided objection against hoops, and it is well known that I advocate, instead of hoops, construction by means of wire. That construction is not my own idea; it is quite as much Captain Blakely's, because he contemplated the thing, too. But with respect to hoops, I think it right to state publicly that I was not prepared to find that so great an advantage could be derived from the use of hoops as is proved to be the case. The question is a purely mathematical one. It is not a matter of opinion, but is as much a matter of demonstration as the laws which hold the planets in their courses. It is shown most clearly that if you have a cast-iron gun of six inches calibre, and the gun itself is six inches thick, and you put on to that a ring of wrought iron three inches thick, with the proper degree of tension you make the resisting power of that gun more than double; that is to say, if it would bear a pressure of four tons to the square inch inside before you hoop it, it will bear nine and a quarter tons after you hoop it. I was not prepared myself for so great an increase; and, having expressed a decided opinion against hooping, I think it right when I find myself wrong to recant that opinion, and to state that the advantage we derive from it is

very much greater than we expected. At the same time, I must state that if instead of that three inches of wrought iron you put on one inch of wire, you will get exactly the same result. I advocate wire because you can lay it on with a tension which is perfectly known to you from beginning to end, whereas the tension with which you put on wrought iron is, more or less, unknown to you. *It is in that tension that the whole secret of strengthening guns consists.* It is here that Sir William Armstrong and Mr. Whitworth are acting contrary to the law which mathematical demonstration points out. Mr. Whitworth is putting on hoops with as great an initial tension as the iron will bear without injury. He puts it on until it is just on the point of a permanent set; consequently, the least more force will give it a permanent set, and will alter the condition of that gun.* I told him he was putting on his hoops in error, without due regard to mathematical tension. Captain Blakely has always put them on with due consideration to that point, and that is one secret of the success which his guns have attained.

I quite agree with Captain Blakely in what he stated with regard to the difference in methods of rifling. There can be no doubt about it. The force which is to give rotation to the shot should be applied to a surface so situated that the whole force shall be in the direction in which motion is intended to be given. That is the practical principle on which rifling should be carried out. The pressure then must come at right angles to the radius. In the hexagon the pressure must be exerted at right angles to the surface of the hexagon. Consequently, if we suppose the pressure is on *B* (fig. 10), that pressure can act only in the direction *B*, *E*, perpendicularly to the surface, whereas to give rotation the pressure should be in the direction *B*, *F*, at right angles to the radius *B*, *O*. In the case of Mr. Whitworth's gun, supposing the whole pressure was exerted at the angle *R*, fig. 12, which is the most advantageous point in his system of rifling, it would exactly double the normal force exerted on the gun. If it was exerted at a point two-thirds down it would treble it. The result of that is very much to increase friction. I mention this because, in a paper which I read at the Institution of Civil Engineers, I stated that in the case of Mr. Whitworth's 80-pounder gun, the amount of friction which was generated on account of the rapidity of the twist, did not amount to more than 3,000 lbs. I meant to say that, not with reference to the particular system of rifling adopted by Mr. Whitworth, but with the most advantageous system of rifling, that the friction *necessary* to give rotation would amount to 2,012 lbs. It is very evident that that was the meaning. Still it was misapprehended; therefore I think it right to explain it.

With respect to the weakening of the gun, alleged as a defect of Captain Blakely's rifling, it has no such effect at all. The depth of the grove is one-sixteenth of an inch, and the fact is, we depend in these hooped guns for the strength entirely upon the material which comes outside the cast iron. The cast iron itself is very little strained, so little, indeed, that in a gun of six inches thickness, when the outer portion is strained with a tensile force of four tons to the square inch, the inside layer would be in a state of compression, consequently so small a re-entry angle has no effect whatever in weakening the gun. If sufficiently strengthened on the outside there is no danger of these rifled guns bursting from any cause of this sort. The real cause of rifles bursting is, that the *inertia* of the shot and the

* Mr. Whitworth's 80-pounder has since cracked.—J. A. B.

decrease of windage is so different from the conditions of the round shot, that the pressure accumulates behind the ball to an extent which it never had before. With a round shot the pressure accumulates to four tons to the square inch, and the shot acts like a valve, and moves away. But with these long shots the pressure accumulates to fifteen or sixteen tons to the square inch, and it can easily be seen that no cast iron, not strengthened outside, can bear more than five or six tons to the square inch; therefore guns burst under these circumstances. It is perfectly impossible for cast iron to bear more than the tensile force of the material inside. All these experiments which have been made have been made in perfect good faith, but I say in a scientific point of view they do not bear upon the subject at all. I hope the Government will take up the subject as it was done in the days of Dr. Hutton; that they will employ a man with Dr. Hutton's knowledge, perseverance, and care, and will put at his command the appliances of the present day, and that they will institute a series of experiments with the present rifled guns, in connection with the ballistic pendulum. If they will do that, I am sure they will put gunnery upon a different footing from what it is now, and we shall not have to go down to Shoeburyness to fire shots of all sorts, and get the most contradictory reports of them, and from those contradictory reports be called upon to express our opinion upon the construction of guns.

Captain F. C. Simons, late Bengal Artillery.—I wish to make a few remarks upon the different figures of rifling. My own impression is, that one field rifle is practically as good as another. But I prefer the old systems to those which have been more recently introduced, and I think the old multi-grooved system of rifling is as good as any known at this day. Perhaps that system which Captain Blakely has indicated, the cog-wheel, is quite as good as any other; in fact, I think it is the best system of rifling which has been brought to notice. But I feel quite persuaded that most excellent cannon can be made, let the figure of rifling be what it may. Though I do not think Mr. Whitworth's system of hexagon, or Mr. Lancaster's oval, or indeed any of the smooth-bored systems, are as good as others, yet I think practically they will be found to answer perfectly well. The reason why I think the smooth-bored system is not so good as others is, because the leverage belonging to them is less. You are all familiar with the action of a capstan when an anchor is weighed. You may put as many levers into that capstan as you like, still the sensibility of the capstan will not be increased. One long lever will raise an anchor much more easily than a hundred short levers, with the same power applied, distributed over them all. To apply that to the case of gunnery, I would say that when a cannon shot is fired two motions have to be given to it: one the forward motion, the other the rotatory motion, and the longer the lever you put into the projectile to produce rotatory motion, though that lever be only one, the more sensible will be the projectile, and the more easily will it come out of the bore. With respect to the hexagonal system, I would say the hexagonal bullet is turned by pressure on half of its six sides. It must be quite evident, that if the pressure were equally distributed on the six sides of the hexagon, the ball could not be made to turn at all; it is by pressure applied on half of each side, acting as six short levers, each as long as half a side of the hexagon at *O*, *T*, fig. 11, that the hexagonal bullet is made to turn. That which makes the oval bullet turn is pressure

upon its two foci; but the pressure upon one focus counteracts to some extent the pressure on the other, and the consequence is that the oval rifle makes its ball turn by a pressure applied to the end of two short levers, situated between the centre of the oval and the foci. Now, in the old system of rifling, the pressure is applied at the end of the whole radius of the circle, and the consequence is, that the balls are what mathematicians term much more sensible. It is as if you were to put a long lever into a capstan instead of a short one. Consequently, the forward motion of the ball as it passes out of the bore is not so much retarded. With respect to the smooth bore system I may further say, I consider the same initial velocity may be given out of one bore as out of another in many instances. Perhaps, in cannon, it may not be the case; but I have reason to believe it is the case with respect to small arms. From what I have heard of the experiments made with Mr. Whitworth's small arms, the superior *inertia* of the bullets fired out of the smooth bore increases the strength of the igniting powder behind it. At one time, it was thought the powder ignited instantaneously; but it is not thought so in the present day. Still, as bullets fired out of bores, where the pressure is applied at the end of the radius instead of near the centre of the circle, come out more easily, and the powder does not come out so strong, therefore I think that the guns are less likely to burst. There is another point I beg to be allowed to advert to. I have heard it stated, that if a ball be fired out of a rifle it will have a tendency to deviate in the direction of the turn. My own impression is, that it has no such tendency at all, but just in the opposite direction, that is to say, if a right-handed spin be given to a ball its tendency will be to deviate to the left. I do not mean to say that such deviation is of any importance, but, so far as it does exist, it tends to deviate to the left. The reason of it is this, that, the air acting upon the wings of the bullet, as the ball passes forward, in consequence of the hinder end of the ball becoming tilted up, it acts with greater force on the under part of the projectile than it does on the upper. I may also say, with respect to the strength of cannon, that Mr. Whitworth's cannon is proved to be perfectly durable. Of course, if they can be made cheaper, as Captain Blakely has suggested, by his system, so much the better; but the great thing is to have strong cannon. It is not fair to artillerymen to give them cannon that will burst. It must be much worse for artillerymen to have guns burst around them than to have shots thrown at them by an enemy. There is another point with respect to these figures of rifling. If a number of air guns were made and rifled with a different degree of turn, and grooves of different figures, and fired at planks, it would then be ascertained by such means whether the forward velocity of the projectile is really more retarded in consequence of certain forms of grooving being adopted. Each should be fired with a given weight of air of a given degree of condensation, as measured by the number of strokes given to the piston by the air-pump. This would get rid of that uncertain ingredient in the calculation, the varying strength given out by gunpowder. I may say, that I consider myself to be the inventor of the Whitworth cannon. In the year 1858, when in India, I published a book in which I recommended that a gun, with a breech screwing on, and not in, should be made, and that a greased wad should be forced in as often as necessary, to keep the bore clean. The object of this breech-opening appa-

ratus was solely with the view of keeping the bore clean. Loading at the breech I do not consider at all necessary for any other purpose. I do not pretend that I recommended the peculiar cartridges which Mr. Whitworth uses, nor his breech-loading contrivance; nor do I wish to detract from the great merit of an enterprising gentleman like Mr. Whitworth. Still I do say this, that in 1858 I recommended a cannon, with a breech screwing on, and not in; and a book in which I mentioned this I sent to Mr. Whitworth in March, 1859. Mr. Whitworth did not take out a provisional protection for that patent till the 30th of August, 1859. I may further say that, two or three years ago, Mr. Whitworth did take out a patent, in which he had a breech screwing on, but it was so regulated to run back that it nearly ran off the gun. It was made with a totally different object in view from that which Mr. Whitworth has with the present breech. I may conclude by saying, that those who really desire to know my opinions will find them in a series of letters which I have written in the last four or five numbers of the "Mechanics' Magazine."

Mr. BASHLEY BRITTEN.—As I wish to be very particular in the statements I make, and to give with accuracy the results I have obtained, more particularly with cast-iron guns, and to point out what I think is a matter of extreme importance, that it is possible to rifle the present iron guns without even hooping them, I have prepared a few remarks, which I will read:—

As my name has been several times alluded to in the course of the evening, not only in reference to the projectiles which Captain Blakely has employed in his recent experiments, but also with regard to the efforts I have made to improve the old guns now in Her Majesty's service by rifling them, I may be permitted to make a few observations.

Six years ago, when I directed my attention to this subject, it appeared to me that improvements in artillery were to be brought about most readily by introducing a better kind of projectile than had hitherto been used. It was obvious that the first thing to be done was to devise some plan for adapting the principle of the rifle to cannon, and it was a very natural thing at the time to look at the Minié bullet for instruction as to the means to be adopted for accomplishing this. The difficulty that at once presented itself was the necessity for devising some plan for uniting a soft metal, like lead, to iron in such a manner as to withstand the shock of discharge from a rifled gun. After some time I found out how this might easily be accomplished, and a projectile formed possessing all the essential qualities of an expanding Minié or Enfield bullet, while the quantity of lead, which is an expensive material for cannon balls, was reduced to a minimum.

We were then at war, and we had a vast number of guns on board our fleet, and in the trenches before Sebastopol, which were positively useless because of their limited efficiency. I saw, or thought I saw, that I had hit upon a plan for improving those guns, and rendering them serviceable. I communicated with the authorities, and entreated for an opportunity of shewing the value of my scheme, but this was at once refused. Sanguine of success, I again applied to the War Office, and consented to bear the expense of such experiments as would be sufficient to establish the correctness of the principle of my invention. I obtained permission to do this,* and, in

* The first experiments were made in the early part of 1855, and the correctness of the

the course of trials made with a rifled 9-pounder cast-iron service gun, in the months of March, May, and July, 1855, results were obtained which led to my being informed officially that further trials would be made with my scheme at the Government expense. With this 9-pounder gun, throwing shells of 14 lbs. weight, with 1¾ lbs. of powder, I obtained at this time a range of 3,200 yards, at 10 degrees elevation, which was 1,000 yards beyond the usual range of such guns with smooth bores, and equal to the range of Sir William Armstrong's 12-pounder gun which, four years after, has been adopted in the service. The shells I then used are in all respects similar to those I have since employed. My proposition was then the same as it is still, viz.:—

Let any or all of the guns in Her Majesty's service be rifled with shallow groves, which would not weaken the guns, and would not at all interfere with the use of the common round shot, but employ also projectiles like those which have been described to-night, with which so great a degree of superior efficiency may be obtained.

I did not propose to substitute other guns for those we had in use, because it was sufficiently obvious that the expense of doing this would be enormous, and that if I could do so much better than had been done before with the guns we had, this surely would be a national boon, and it would naturally follow that when stronger guns than our old ones should be constructed, still greater proportionate results could be obtained with heavier charges and heavier shot than it would be safe to employ with the guns we had then in use. At that time there was not so much known about this subject as there is now; there was only the Lancaster gun under trial: nor was the actual strength of the cast-iron guns so well known. The task I undertook was, therefore, not an easy one, for I had not only to determine the rifling suitable for projectiles like mine, but I had also to adapt the weight of my projectiles and the charges of powder to the

principle of the invention was then fully established. The following guns have now been tried under official superintendence. Up to the present time (December 1860) there have been fired from the unstrengthened Rifled Service guns—

				About.
From the	2—9-pounder Rifled Guns,	54 rounds of	Shells,	14½ lbs.
,,	1—32 ditto (rifled in 1856),	300 ,,	,,	48 ,,
,,	1—32 ditto (rifled in 1860),	300 ,,	,,	48 ,,
,,	1—68 ditto (rifled in 1860),	300 ,,	,,	90 ,,

Four other guns, rifled in 1860, have been subjected to another trial of a severe character, with a view to test their strength as Rifled Guns:—

From each of 2 Rifled 32-pounder Service Guns, 58 cwt. each—
10 Rounds, with proposed Shells of 48 lbs. each.
10 Rounds, with heavier Shells, on same principle, 72 lbs. each.
10 Rounds, with solid Shot, on same principle, 96 lbs. each.

From each of 2 Rifled 68-pounder Service Guns, 95 cwt. each—
10 Rounds, with proposed Shells of 90 lbs. each.
10 Rounds, with heavier Shells, on same principle, 135 lbs. each.
10 Rounds, with solid Shot, on same principle, 180 lbs. each.

The main object of all these experiments has been to ascertain whether the cast-iron guns are strong enough to be converted into rifled guns on my system, without undergoing any process of strengthening. The result has been that in no instance has any Service Gun burst or apparently suffered injury, to which this system has been applied.—B. B.

strength of the guns. A single mistake, involving the bursting of a gun, I knew would be fatal to my efforts.

The repeated failures of the Lancaster gun, involving sacrifice of the enormous sums of public money which were lavished on that system, induced the belief that cast-iron guns were not strong enough to be rifled; but the fact that whenever the Lancaster guns burst, it was always in front of the trunnions, while guns which burst under proof charges always go in rear of them, was a clear proof to my mind that the cause of bursting was not the charge of powder, or the weight of the projectile, but was connected with the method of rifling, and the employment of a rigid shot, at any time liable to get jammed in the gun.

I avoided this danger entirely by the employment of lead, which would give way before the rifling could produce any excessive strain on the gun. I also employed grooves, which weakened the gun much less, and likewise made use of a spiral of considerably less twist.

Now, although during the years 1856, 1857, and 1858, I was constantly importuning the authorities for leave to continue my experiments, very little was done till the following year. On reviewing what had been done, it was then considered that my proposal had not been sufficiently disproved. I was consequently desired to make another trial with the 32-pounder gun which had been rifled for me in 1856, from which I had been only allowed to fire seven rounds. This further experiment produced results which seemed to throw new light upon the question. Since then many other experiments have been made, which have all tended to confirm the view expressed by me originally. I will now explain, as briefly as I can, what these experiments have been.

The service guns which I have used, with nothing done to them but planing out the grooves, with the charges of powder and weight of projectiles, will be seen below.

RIFLED CAST-IRON SERVICE GUNS UNSTRENGTHENED.

	Cwt.	Charges.	Weight of Projectiles.	No. of Rounds.
9-pounder ..	17 ..	1½ to 2¼ lbs. ..	13 to 15 lbs. ..	24
9-pounder ..	17 (No. 2)	1½ to 2 „ ..	13 to 16 „ ..	30
32-pounder ..	56 ..	5½ to 6½ „ ..	48 to 51 „ ..	75
32-pounder ..	58 (No. 2)	5 to 6 „ ..	48 to 51 „ ..	176
68-pounder ..	95 ..	6 to 8 „ ..	88 to 100 „ ..	130

The above are all the service guns which have been tried on my system, and not one has yet burst, or shown any sign of injury. They have not burst simply, I suppose, because I have not overloaded them. Any gun will burst if overloaded, but why should rifled guns be overloaded beyond their strength? I know not what is meant by the expression, "Our old guns are not strong enough to be rifled." This question has been much embarrassed by the heedless manner in which different inventors of rifled ordnance have charged their guns. Elongated shot can, of course, be made of almost any weight; and these heavy shot in rifled guns have the power of converting a given quantity of gunpowder into a far more powerful agent than any round shot could do. The mere prevention of windage will render 10 lbs. of powder equal to a charge of at least 15 lbs. where there is windage to any extent. The consequence has been, that many cast-iron

rifled guns have been loaded beyond their strength, and have necessarily failed, and the cause has been assigned to the uncertainty of the metal rather than to the severe conditions under which it was tried. In order to show that excellent results may be obtained from rifled service guns without employing excessive charges, I will now state the results of a few of my experiments.

My guns have all been fired under the ordinary conditions, no kind of lubrication has been used, and no attempt made to adjust the trunnions horizontally, or any other refinement; and in the particulars I am going to give I have not made any selection of good shots.

In February last year, I fired from one of my 32-pounders eighteen shells 48 lbs. each with 6 lb. charges. At 10° elevation the average range was 3,450 yards, and the average deviation right or left of the line of aim was 5 yards. In March, 1859, ten rounds of similar shells with the same charge and the same elevation gave an average range of 3,490 yards, deviation right or left 6 yards. Now this may be compared with six-pound service shot fired in May last year, by way of comparison, from a 32-pounder smooth-bored gun with the service charge of 10 lbs. of powder, when the range obtained at $10\frac{3}{8}$° averaged only 2,738 yards, and at this distance the mean deviation right and left exceeded 25 yards. In November last year, twenty-five rounds fired from my rifled 32-pounder with 5 lb. charges at 5° elevation, gave an average of 1,845 yards, with 2 yards lateral deviation, and on the same day twenty-five rounds more at 10° with the same charge averaged 3,111 yards with but 4 yards deviation from line of aim. In January last, twenty rounds at 5° with 5 lbs. charge went 1,831 yards with a deviation of $3\frac{1}{3}$ yards, and twenty-four rounds at 10°, 3,263 yards with $4\frac{2}{3}$ yards deviation.

With these small charges the recoil of the guns is invariably less than with similar guns smooth-bored on the same platform fired with the service-charges, and, as recoil must be an indication of comparative strain from within, there can be no reason for the belief that the rifled guns were at all overtasked. With these facts before me, how can I receive any person's dogma as to the impracticability of improving our stock of guns?

It is then to these facts I appeal when I ask the Government to proceed with the investigation of this important question, and not to decide too hastily about condemning our vast stock of ordnance. It will be seen that the benefits to be derived from the rifled ordnance are not simply greater range and superior accuracy, but it also consists in the greater weight of metal thrown and the more destructive nature of the projectile. I will state this more clearly by giving the following summary of advantages:

1. My plan can be applied at once to the iron and brass guns now in Her Majesty's service. To rifle the present guns is a very simple operation, which may be performed with portable machinery worked by hand labour, either on board ship or elsewhere.

2. When so altered, the guns will be capable of discharging projectiles more than half as heavy again as the present solid shot for the same guns, and of a far more destructive character.

3. The new projectiles for the altered guns will not only have greater force and penetration, but they will have an effective range exceeding by several hundred yards that of the present solid shot.

4. The altered guns will command greater accuracy up to 4,000 yards than the present guns have at 2,000 yards range.

5. The new projectiles, besides having the advantage of greater weight, length of range, and accuracy than the service solid shot, are explosive shells. These shells will hold three times as much powder as the service shells for the same guns, and they can be fired so as to explode at any distance, or only at the moment of striking.

6. Shrapnel shells on the same principle will hold more than three times as many bullets as the common Shrapnel for the same guns, and have a longer sustained velocity.

7. The present guns, when rifled on proposed plan, can still be used as effectively for round or case shot.

8. My projectiles can be made for so little cost beyond that of the common shells, that the saving of powder effected in the requisite charge for the gun would be an equivalent.

9. By strengthening the present service guns in a manner which has been tried and proved effectual, the above advantages may be further increased, and results obtained equal to, if not surpassing, anything yet accomplished with the recently adopted breech-loading rifled cannon, which are of the most elaborate and expensive construction.

The last point here mentioned I have not yet adverted to. Before doing so, I would ask whether these combined advantages to be derived from the old guns by merely rifling them (and this could be done for about 30*s.* each) does not really amount to more than doubling their present efficiency, and is not this worth gaining? I say then let any or all of our guns be rifled without loss of time, and let such charges of powder and such projectiles be used as conclusive trials may prove they will safely bear. We know not how soon we may want them; therefore, why should time be lost? There is no necessity for resting content with this. Those guns when so rifled may be made to do far more work still. As leisure serves, they might have wrought-iron or steel hoops placed round them from the trunnions to the breech, and this would render them as good as any guns which, in my opinion, could be made of any material or at any cost. How far Capt. Blakely may be entitled to claim this plan as his own, I am not called upon to express any opinion, but I do believe he has done far more than any one else to show how far this may be effected, and it certainly appears to me, that what he has done, has not been fairly acknowledged.

Besides the service guns which I have before spoken of, two other guns have been rifled on my system. They are cast-iron guns, with a greater thickness of metal. I have experimented with them in such a manner as to show as far as I could with them the better results which might be obtained from our guns when rifled and strengthened with hoops. One of these guns has the bore of a 32-pounder, the other that of an 18-pounder. From the 32-pounder I have fired 100 rounds of shells of 58 lbs. each, and about 7 lb. charges, with the following degree of accuracy:

No. of Rounds.	Average Range. Yards.	Deviation right or left. Yards.	Feet.
21	952	0	2¾
21	1,937	1	1¾
21	2,485	2	1¼
21	3,264	3	1
16	3,612	3	1¼

From the 18-pounder, which had an extra three-quarters of an inch in thickness of cast-iron beyond the service-pattern—and this gave little additional strength to the gun, I have fired shells weighing 34 lbs. with charges of 6½ lbs. of powder, and obtained the following results:

No. of Rounds.	Average Range. Yards.	Deviation right or left. Yards.	Feet.
21	1,110	1	1
5	2,080	1	1¾
8	3,750	2	2

This gun, which had never been subjected to the usual proof in order to test the soundness of the metal, unfortunately burst. The strain to which it was subjected by the above charge, although greater than it would be safe to employ with ordinary cast-iron guns, is not nearly so great as the system of hooping would supply.

The above range of 3,750 yards with 34-lb. shells, which was at an elevation of 10 degrees, is somewhat greater than that of Sir William Armstrong's 32-pounder breech-loading wrought-iron gun; and considering that the above practice took place with the wind blowing across the range with the registered force of 6 to 7, which is really a gale of wind, the deviations are remarkably small. Any greater degree of accuracy than this would certainly be valueless. My belief is, that there is not a gun in the service which might not be made to do as well or even better than this gun, by rendering it strong with bands of good iron round the breech. For my own part I desire to have no better guns than hooped service guns for showing the utmost that can be done with my system of rifled cannon. From inquiries I have made, I am satisfied that the cost of thus strengthening our guns should not exceed a fourth of their original cost; why, therefore, this important point has been so coldly treated, while such strenuous efforts have been made to hasten the manufacture of other guns, more costly in material and far more elaborate in construction, is a question which I am unable to solve. I have seen an instance in which a wrought-iron band more than an inch-and-a-half thick was shrunk upon the breech of a cast-iron gun, where the metal was more than six inches thick, and, when the gun was proved with a very heavy charge, the wrought-iron band was broken, and the cast-iron gun remained sound. No clearer proof can be given that good cast-iron is sufficiently elastic to transmit the strain from the inner to the outer circumference of cylinders of this thickness, and on the outer circumference wrought-iron or steel bands may be put of any degree of strength.

Mr. Lawrence.—The reason I wish to speak upon this subject is because Captain Blakely in his paper gave me credit for producing the second-best gun. The principle on which that gun was made is precisely the same as that explained by the gentleman who spoke immediately after Captain Blakely [Mr. Hadden], viz. that of making wide and shallow grooves, and giving a very considerable twist to those grooves. The question of priority has been alluded to, and I cannot help thinking it has been spoken of rather lightly, because, when a thing has once been done, surely there can be no great merit in following in the footsteps of the first

person. The party who opens the way for others must surely possess a greater merit than those who merely follow in his footsteps. Mr. Bashley Britten has claimed to produce very considerable results, but those which I have obtained still possess a great superiority. I obtained at an elevation of 5 degrees a range of 2,595 yards; at an elevation of 10 degrees a range of 4,000 yards; and, at an elevation of 28 degrees, a range of 7,300 yards; and this with solid shot of 80 lb. We have to consider—not the easiest and cheapest mode of making guns, but the sort of guns we should most likely have to contend with. We ought to have looked at the results the French have produced, which the Russians have attained, and also the Americans. These are the three powers, that, if we quarrelled at all, we should most likely quarrel with. It is clear to me that the gun which Captain Blakely has stated to be on the French system is a much more powerful one than the one we have, obliged as we are to reduce the charge of powder in order to allow for the weakness of the gun. We ought to have a gun in which we could put the greatest charge of powder that would be necessary to project our shot. It is no use putting too much powder, because you do not produce greater results by that means, but you ought to have a gun sufficiently strong to bear the greatest amount of powder that is requisite to project a shot the greatest distance. My original attempt at invention was with a bullet in 1852. I then made a cannon-shot on the same principle; but on trying it I found that that was only half the invention; that the gun required improving precisely as much as the shot itself. It was a considerable period before I could adopt the principles which I found would obtain the best results—not until 1855. At that time I had the authority of the Government for making an eighty-pounder gun. It weighed 95 cwt. and was what is ordinarily understood as a sixty-eight pounder. From previous experiments, I felt convinced that it was requisite some additional strength should be given to that gun; and I therefore suggested that, instead of the gun being bored to the whole extent—eight inches, it should be reduced to six and three-eighth inches, which gave of course greater strength to the gun. The rifling I recommended to be reduced from two-tenths of an inch, which was the original form given by the authorities at Woolwich, to one-tenth in the centre of the groove. That was tried, and the gun constructed on that form was made, I believe, at Low Moor. It was certainly rifled at Woolwich, and was tried at Shoeburyness in May 1856. I never saw the gun till it was fired, nor do I believe the officer did who fired it. Nineteen shots were fired from that gun at various elevations, from point-blank range up to ten degrees. The extreme range was 4,125 yards. The charges used were various—from 12 lb. up to 16 lb., and the accuracy was such that twelve out of those nineteen shots only varied from the right line one yard and one-fourteenth. One of the shots reached upwards of 4,000 yards, and was just three yards out of the straight line. Notwithstanding those results, I was not allowed to continue the experiments with that gun; and it was not till three years and a-half afterwards that I was able to take another step. On that occasion the gun was fired at ten degrees and at twenty-seven degrees. At ten degrees it produced similar results to those on the previous occasion—it ranged 4,000 yards. At twenty-seven degrees it ranged 7,300 yards. There was one peculiarity in the greater range, that the shots fell

close together. Only forty-eight yards on the average was the difference in 7,000 yards, and the time of flight was thirty seconds. That gun was subsequently tried for penetration, and, as Captain Blakely told you, it burst. But the reason of its bursting was this. On every occasion, from the first, I pointed out the necessity of lubricating expansive cannon-shot. I had used grease. On the last occasion no grease was used; consequently, the expansion of the shot not being eased by the use of any lubrication, the shots, I suppose, blocked and burst the gun. I have fired nine-pounders, and cannon of other calibres, and have had no accident whatever. I therefore attribute the bursting of that gun to the absence of grease; every other person when he fires rifled cannon-shot uses grease. I believe Mr. Whitworth is most particular in the use of that substance.

Mr. BRITTEN.—I use no grease, nor anything of the kind.

Mr. HADDAN.—I use no grease. Might I ask one question? When you talk of extreme range, do you mean the range with the first graze?

Mr. LAWRENCE.—The first graze decidedly. In speaking of these experiments, I quote from official documents. I have never made an experiment myself; they have always been made at Woolwich or Shoeburyness. I should like to explain the nature of my shot, which is entirely different from that of any other gentleman. The forepart is made of zinc, and the hinder part of lead. The weight of the shot is 32 lb. or 68 lb. The length of the shot is $8\frac{3}{8}$ inches. The effect of using zinc and lead in that manner is this: when the bullet strikes against an object the zinc does not give way, but the lead does, and it takes from the force of the shot, just as a person in jumping from a height bends himself—he does not feel the effect of the fall. This was proved to be beneficial by firing against sand, against 14-inch oak, and against granite. Therefore, it is not a mere theoretical advantage, but it has actually been proved in practice. The object in making shot about $1\frac{1}{3}$ diameter instead of a long shot, is that you get a better second graze in a direct line, while with all the long shots you cannot depend upon where your shot gets the second graze; it will go to the right or the left. Another advantage which I get from using that kind of shot is, the certainty of a perfect joint which time will not affect. In all shots which are made of iron connected with lead, time must certainly have an effect upon the goodness of the joint. It would be impossible to make shot fresh and fresh; you must have some in store, and the result will be this: that when you come to use them after a considerable time your shots will be found in many cases unserviceable. Another point is this: there have not been sufficient experiments with large shot of that description, to ascertain whether you can make a perfect joint in them. With light shot you can; but I have much doubt whether with large shots a perfect joint can be made.

Mr. HADDAN.—As the gentleman who is the friend of Mr. Whitworth, and knows all that has taken place, is about to leave the room, I would ask him whether the 80-pounder gun tried at Southport, two or three weeks ago, did not blow the breech off?

Mr. ASTON.—All I can say is, that the 80-pounder which was fired at Southport the other day sent every shot——

Mr. HADDAN.—(Interrupting.) That is no answer to my question.

Mr. ASTON.—All I can say is, that when I was at Southport I saw certain results, and when I was at Shoeburyness I saw certain results.

CAPTAIN BLAKELY.—I will trespass a very short time on your patience. I would merely remark, that the great success, both of the Lancaster and Whitworth small arm, must not make one suppose that the system is equally good for cannon. In a small rifle great friction gives time for the powder to burn, and the power is accumulated behind the shot. Now, the great weight of the large shot is quite sufficient to give full time for this. No unnecessary friction is required. In a large gun, therefore, I think we should rather ease than impede the passage of the shot.

Mr. Aston has read us portions of Mr. Whitworth's specification, with a view to show that he patented in 1854 the plan of constructing cannon which I advocate; and Mr. James Longridge has told us that he on the contrary pledges his reputation that Mr. Whitworth's specification contains no description of any plan similar to mine. Luckily Mr. Aston has Mr. Whitworth's specification here to refer to and settle this question; and if he will permit me I will read the sentence in it immediately following those he read—

> When it is important that the weight in a small cannon or fire-arm should be diminished, instead of constructing them in segments as above described, I find it more convenient to make the tubular part in one piece.

I cannot think how this can have escaped Mr. Aston's attention, proving as it does that Mr. Whitworth believed a tube made in one piece to be stronger than one made according to his own patent, viz., of longitudinal staves hooped together. Some may think that Mr. Whitworth meant to hoop the tubes made in one piece, but such cannot have been his intention, for he goes on to say that he makes these tubes taper from breech to muzzle, and casts the trunnions on. A glance at a sketch of a gun thus formed (fig. 15) will convince any one that hoops cannot be put on, except from the muzzle to the trunnions. I had better read his own words, and let you compare them with my sketch. He says:—

> I make the exterior to taper from the breech to the muzzle, either of the ordinary conical figure, or of a spiral angular figure corresponding with the figure of the interior, so that in any transverse section there is uniformity of thickness and strength of metal. In the case of cannons so constructed, the trunnions are cast on.

It is therefore clear that he meant to leave these guns unhooped. Why, then, did Mr. Whitworth not make all his guns of one piece? I will answer by again quoting his specification:—

> The danger of a gun bursting from an over charge of gunpowder will be obviated, because the strain will be distributed throughout the length of the segments, and by forcing the hoops or belts to give way will cause the joints of the segments to open longitudinally, thus acting as safety valves, allowing the gases generated by the explosion to escape through the joints so opened. The piece may be spoiled by overstraining the parts, but its liability to burst will be prevented. In the case of heavy pieces of ordnance the facilities of transport are much increased, as by removing the hoops or belts the various parts may be disconnected and transported separately.

The escape of gas he obtained I have no doubt, and he may have been able to take his gun to pieces. I wish it, however, to be understood, that guns made on my plan do not possess these advantages. To enable the hoops to save the interior, they must grasp it far too tight ever to be removed, *and the gas I prefer to confine.* I need not take up any more of your time in proving that Mr. Whitworth contemplated neither the hooping of

continuous tubes at all (as distinguished from tubes made of separate segments), nor putting on hoops with proper tension to prevent the escape of gas. As visitors go through the hall now, on leaving this theatre, I would ask them to look round. They will see several cannon, hundreds of years old, built of staves and hoops. I can assure Mr. Aston that I do not claim the invention of these. This would be an ill-chosen place to do so.

There are many inventors engaged in the same field of research we have discussed to-night, whom I have not named. This is not by any means because I undervalue their labours, but simply because I have not a sufficiently accurate knowledge of them, to lay it before this Institution.

The Journal

OF THE

Royal United Service Institution.

VOL. IV. 1861. APPENDIX.

PROCEEDINGS OF THE THIRTIETH ANNIVERSARY MEETING.

THE THIRTIETH ANNIVERSARY MEETING of the Members was held in the Theatre of the INSTITUTION, on Saturday, March 2nd, 1861.

His Grace the DUKE OF SOMERSET, First Lord of the Admiralty, in the Chair.

I. The Proceedings of the last Anniversary Meeting were read.

II. The Proceedings of the Special General Meeting on the 3rd March were read.

III. The Annual Report of the COUNCIL was read as follows:—

1. In this, the Thirtieth Annual Report, and the first since the grant of a Royal Charter of Incorporation, the COUNCIL are able to congratulate the Members of the ROYAL UNITED SERVICE INSTITUTION upon the steady and decided progress which has been made during the past year. The COUNCIL have received letters from many of the Members, expressing approval of recent measures, and testifying to the increasing usefulness of the Institution.

2. While offering their thanks for the cordial co-operation afforded in answer to the appeal of last year's Report, the COUNCIL desire to draw attention to the fact, that military science is passing rapidly through new phases; this fact enhances the value of the Institution, and renders its effective support of higher importance to the United Services than at any former period.

3. Some of the improvements referred to in last year's Report have been carried out. Considerable expense has thereby been entailed, but the increased support which has been received by the Institution has placed its finances in a condition equal to that of any previous year, and has improved its prospects, as will be seen by the following details.

Members.

4. The number of Members enrolled since the 1st of January, 1860, amounts to 300. The loss sustained by death is 98, by withdrawal 15; and the names of 13 have been removed from the list, in consequence of their subscriptions having remained unpaid for two years and upwards, notwithstanding repeated applications for them. The increase on the year is, therefore, 174, as compared with 98 in the previous year. A detailed statement of the changes among the Members, and a tabular analysis, showing the present state of the Institution compared with that of former years, appear on pages xv. and xvi.

Finance.

5. The usual General Abstract of Accounts for 1860, as audited on the 2nd of February, 1861, will be found on the opposite page.

Receipts.

6. The ordinary receipts have exceeded the amount estimated by £327. 812 Members have during the past year raised their Subscriptions from ten shillings to one pound and upwards; 124 Life Members have either paid an annual subscription of ten shillings or more, or have paid a further composition on their original life subscriptions. The donations have amounted to £14 2*s.*; the sale of the collection of Natural History produced £218 6*s.* 8*d.*; and a sum £876 14*s.*, being the legacies of Mrs. Watson and of Major-General Law, has been received.

Expenditure.

7. In consequence of the improvements made since last year's Report, and of the greater development of the Institution, the expenditure has exceeded the estimate, as follows: by sending the Journal direct to members through the post, in preference to the longer route through the Clothing Department, £48; in the purchase and binding of books, £14; for stamps, lithographing circulars to Volunteer Corps, and to Corresponding Members of Council, and for the alteration of dies, plates, &c., consequent upon the receipt of the Charter, £33; for printing the Annual Report, copies of the new Bye-laws and Charter, and papers relative to the change in the laws, laid before the Special General Meeting, a sum of £24.

The cost of the Journal exceeded the estimate by £89 in consequence of a large increase in the number of the Members, and a greater demand for it amongst the original Members. The cost of the Charter and the Corporation Seal was £221 0*s.* 6*d.* The latter sum, which may be considered as chargeable against capital, has been nearly covered by the receipt of £218 6*s.* 8*d.* from the sale of the Natural History Collection; a sum of £112 was expended for colouring and painting, rendered neces-

GENERAL ABSTRACT OF THE ACCOUNTS OF THE ROYAL UNITED SERVICE INSTITUTION

FROM 1st JANUARY TO 31st DECEMBER, 1860.

EXPENDITURE.	Amount. £ s. d.
Secretary's Salary	200 0 0
Clerk's do.	72 0 0
Servants' Wages	352 17 0
Do. Clothing	57 5 0
Fuel	54 6 6
Lighting	26 18 9
Postage	118 6 4
Fire Insurance	30 1 6
Library	114 5 3
Journals	589 10 10
Advertisements	32 5 9
Artificers, Carpenters, Ironmongers, Painters, Glazing, &c.	212 3 2
Stationery, Printing, Circulars, Tickets, &c.	123 1 11
Lectures	22 10 0
Assessed Taxes	86 17 7
Income Tax	2 5 0
Parish and Water Rates	105 9 2
Ground Rent	199 1 8
Domestic Sundries	17 7 10
Miscellaneous	58 6 11
Annuity to Malcolm	20 0 0
Stamps	7 5 6
Powers of Attorney	2 16 4
Reprints of early Journals	59 17 9
Annual Report	74 14 6
Re-arranging Charts, Maps, &c. in Topographical Room	10 12 6
Repairing and Painting outside of Building	52 10 0
Royal Charter	221 0 6
Total Expenditure	£2,923 17 3
Cash repaid to Agents	5 0 0
Balance of Petty Cash returned to Bankers	3 10 6
Invested in purchase of Consols	1153 5 9
Balance at Bankers on 31st December, 1860	177 19 10
Total	£4,263 13 4

RECEIPTS.	£ s. d.	Amount. £ s. d.
Balance at Bankers 31st December, 1859		46 1 1
Annual Subscriptions at 10s. for 1860	848 15 0	
Do. do. above	1,067 4 0	
Do. do. arrears	28 17 0	
Do. do. advance	16 10 0	
		1,961 6 0
Entrance Fees		298 0 0
Donations		14 2 0
Grant from Government		400 0 0
Life Subscriptions		397 10 0
Dividends		28 14 4
Sale of Natural History		218 6 8
Sale of Journals		19 2 6
Sale of Waste Paper		0 5 7
Legacy from Major-General W. H. Law, K.H. ret. full pay, 83rd Regt.		450 0 0
Do. from Mrs. Watson		426 14 8
Balance of Petty Cash returned to Bankers		3 10 6
Total		£4,263 13 4

London, 2nd February, 1861.

Examined and found correct, THO. SMITH. J. E. A. DOLBY. } Auditors.

sary by the removal of the collection of natural history; the carriage of arms, accoutrements, &c., presented by foreign governments, entailed a further expense of £8 more than had been anticipated; an expense of £14 was incurred on improvements in lighting and warming the building during the lecture season; an addition of £50 per annum was made to the salary of the Secretary, an expense which was incurred by the COUNCIL after full consideration of the duties and responsibility now devolving on that officer. The total excess of expenditure over estimate is thus £613 0*s.* 6*d.*

8. The COUNCIL have continued to invest in Government Stock the Life Subscriptions received during the past year (of which £167 have been invested since 1st January), together with the sums received in composition of annual and increased life subscriptions, which, with the legacies of Mrs. Watson and Major-General Law, amount to £1,153 5*s.* 9*d.* The funded property of the Institution, therefore, now amounts to £2,360 5*s.* 8*d.* Three per Cent. Consols.

9. ESTIMATE OF PROBABLE RECEIPTS AND EXPENDITURE FOR 1861.

EXPENDITURE.	AMOUNT. £	*s.*	*d.*
Secretary's Salary	200	0	0
Clerk's Salary	72	0	0
Servants' Wages	356	0	0
Ditto Clothing	50	0	0
Fuel	55	0	0
Lighting	30	0	0
Postage	130	0	0
Insurance	29	5	0
Library	100	0	0
Journals	550	0	0
Advertisements	35	0	0
Artificers	60	0	0
Printing Circulars, Tickets, Stationery, &c.	100	0	0
Lectures	20	0	0
Assessed Taxes	88	0	0
Income Tax	2	10	0
Parish and Water Rates	105	0	0
Ground Rent	200	0	0
Domestic Sundries	20	0	0
Miscellaneous	50	0	0
Annuity to Malcolm	20	0	0
Reprint of early Journals	50	0	0
Printing Annual Report	50	0	0
Printing List of Members	50	0	0
Purchase of Models, and improvements in Museum	200	0	0
Ditto, and improvements in Naval Department	100	0	0
Purchases and improvements Topographical Department	50	0	0
Alteration in Lecture Theatre	40	0	0
Balance	84	15	0
Total	£2897	10	0

RECEIPTS.	AMOUNT. £	*s.*	*d.*
Annual Subscriptions:			
At 10*s.*	900	0	0
At £1 and upwards	1200	0	0
Entrance Fees	300	0	0
Dividends	66	0	0
Sale of Natural History	11	10	0
Sale of Journals	20	0	0
	£2497	10	0
Parliamentary Grant	400	0	0
	£2897	10	0
Total	£2897	10	0

The Journal.

10. The arrangement by which Members, whilst serving abroad, can receive the Journal without paying the additional subscription of 10*s.* per annum, has given much satisfaction; in one regiment six officers, in another seven, in a third eight, and in a fourth twelve, have requested to be enrolled as Members of the Institution. The charge for its postage to Officers abroad amounts to a considerable sum, but this is more than compensated by the advantages afforded. This publication is now proving one of the great sources of the Institution's prosperity.

Topographical Department.

11. A complete Catalogue of the various maps, plans, drawings, &c., in this department is being made, and the Council trust to have them so arranged, as shortly to afford every facility for reference. The catalogue and arrangement of the charts have been completed. The charts published by the Admiralty, and the plans and maps by the Topographical Department of the War Office, have been regularly supplied; and the Institution is indebted to Lord Amherst for the present of a collection of maps and plans, chiefly manuscript, formed by his distinguished ancestor Field-Marshal Lord Amherst. The Council take this opportunity of expressing their sense of the great value of these donations to the Members.

Library.

12. Besides the books of reference purchased for the Library, the Council have received two additional volumes of a Naval and Military Journal from the Government of Denmark; one volume in addition to the Memoirs of the Topographical Depôt, St. Petersburg, from the Government of Russia; and from the Belgian Government two volumes of works on the survey of Belgium, with sundry other pamphlets.* A list of other works added to the Library during the past year will appear in the Appendix to Vol. IV. of the Journal.

Museum.

13. The Collection of Natural History, the sale of which was sanctioned at the Special General Meeting, has been disposed of for the sum of £229 16*s.* 8*d.* The rooms which it occupied have been re-coloured and painted, and are now set apart, one for Military Models, and the other for Foreign Accoutrements. The Museum has been enriched during the past year by liberal donations of arms, clothing, and accoutrements from the Governments of Denmark, France, Greece, Hanover, Holland, and Switzerland. Similar donations are expected from the United States of America, Bavaria, Russia, Saxony, Spain, and Sweden.

Lectures.

14. The Council take this opportunity of acknowledging their obligations to the officers and other gentlemen who delivered Lectures or read papers during the past season. They regret that they have been unable to obtain a lecture containing a complete *résumé* of the progress of naval and military science during the past year.

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* To the above should be added Nos. 21, 22, and 23, of the Topographical and Military Map of the Netherlands, presented by the Netherlands Government.—Ed.

Honorary Members.

15. The Council have much gratification in announcing that Lady Franklin has become an Honorary Member.

Corresponding Members of Council.

16. The Council being of opinion that it is desirable to have in each regiment and depôt of the Army, and on each Naval station, some officer who would more particularly forward the interests of the Institution, have revived the office of Corresponding Member of Council, and to their appeal seventy-eight have already responded. The warm thanks of the Institution are due to these gentlemen for the great assistance which they have afforded.

Vice-Patrons.

17. The Council regret to record the death of the Duke of Norfolk, who took a great interest in the Institution; also that of the Duke of Richmond and of Field-Marshal the Earl of Strafford. The latter two noblemen participated in the great events of one of the brightest periods in our military history; at the close of the battle of Waterloo, the Earl of Strafford commanded the first division of the army.

18. General Lord Clyde, for many years a Member, has accepted the office of Vice-Patron of the Institution.

Vice-President.

19. By the death of Captain Ford, the Institution has lost not only one of its oldest, but one who, as long as health permitted, was among its most active Members.

Bequest.

20. The death of Major-General Law has deprived the Institution of a most zealous friend. The Institution is indebted to him for the munificent bequest of £500. The Major-General served for some time in the Peninsular War.

Volunteer Corps.

21. The Council recommended an alteration in the laws, with a view to the admission of the officers of this patriotic body on the same footing as those of the regular services. Sanction was given at the special general meeting, on the 3rd March, 1860, and they are now eligible.

Trafalgar Model.

22. The artist has been unable to complete this model by the time anticipated, but considerable progress has been made, as may be perceived on visiting the Naval Model room.

In Conclusion.—Their anticipations having been hitherto fully realised, the Council look with confidence to the future. With a view to further progress, the assistance of every Member of the Institution is earnestly desired, and the Council suggest that most effective aid may be afforded by officers serving abroad transmitting papers for evening readings, and for subsequent notice or insertion in the Journal.

IV. Colonel JOHN CLARKE KENNEDY, C.B.—

MY LORD DUKE, and GENTLEMEN.—In submitting to you the Resolution with which I have had the honour of being entrusted, namely, "That the Report now read be adopted and printed for circulation among the Members," I will not detain you with many remarks; still there are several points which I think ought to be brought distinctly to the notice of the Members now present. Last year, when we met in this room, we were full of anticipation of the increasing advantages and prosperity of the Institution. This year, I think we may congratulate ourselves that the events of the last twelve months have fully borne out the anticipations which we then formed. The liberality of many of the Members of the Institution, to the number of upwards of 800, in increasing their subscriptions from 10*s.* to £1 and upwards, should not be passed over without remark. The extension of the circulation of our Journal is, perhaps, after all, the most important event of the past year. The instruction which we who reside in the neighbourhood receive in this room, is now carried from one end of the world to the other, by the Journal being distributed amongst our brother officers of both services who are serving abroad. The great advantages which naval and military science will derive from this distribution of our Proceedings, needs very little remark from me; it is self-evident. The very fact of the Journal being distributed throughout our colonies will in time, I hope, bear fruits, by the officers, who must have much spare time abroad, devoting that spare time to sending us the results of their observations and their experience. I therefore think, and I am sure the Meeting will agree with me, that the money that we have expended upon it, though large the sum may appear, has been well and satisfactorily laid out. With regard to the Library and Museum, any of us who are in the habit of spending a few hours here occasionally, will also bear testimony to the great improvements which have taken place during the past year. Any one who visits the Equipment Room, who visits the Library, who wishes to inspect a plan, can at once through, I must say, the ever ready courtesy of our Secretary and the Officers of the Institution, find any book or any plan he wants without the slightest difficulty. This is no slight advantage to a body of officers who can only, in their own houses, have but a limited library. As to the Lectures, I believe I shall be borne out in stating, that during the past year they have been even more interesting than in former years. It would be invidious indeed, on my part, to name specially any gentlemen who have favoured us with the result of their labours; but, in stating that I think the Meeting should give these gentlemen their thanks, I am sure I am only expressing the opinions of you all. There is one point upon which I am afraid we have been, perhaps, a little disappointed. Last year we were in hopes that those gentlemen who have voluntarily joined us in the service of their Queen and country, would also have joined us in supporting this Institution. Some, certainly, have done so; and I only hope that, when they have got through a little more of their drill, they will come and join us, with a view of extending, what I may almost call, their professional knowledge. Most of us are connected with friends in the Volunteers, and, I think, each of us ought to exert himself to induce as many officers of the Volunteer force as possible, to become Members of this Institution. I will not detain you any longer, but will move, "That the Report now read be adopted and printed for circulation among the Members."

Rear-Admiral AUSTIN, C.B. seconded the Resolution.

Lieutenant GARDINER, R.N.—

I beg leave to call your Grace's attention to the fact, that last year this Institution was incorporated, and up to the present moment, I have heard, the bye-laws have not had the seal of the Corporation affixed to them; and until that seal is affixed at a General Meeting, they are void, Therefore this Meeting is summoned by a Council that has not been duly elected. It is utterly impossible to get rid of that fact, because these bye-laws, to be binding upon the Institution, should have the common seal affixed to them. I think your Grace will bear me out, that I am not incorrect in the statement I now make. I would suggest, with all sincerity, not wishing to create difficulties, that we should refer these bye-laws to a Committee, who should draw them up and have them properly framed, and then submit them to a General Meeting, to have the common seal affixed. Then you will be in a position to carry them out; but until that is done, they are of no more value than the paper they are written on.

Lieutenant Gardiner then quoted an authority on the subject, and sub-

mitted that the Bye-Laws, as they at present stood, were not in conformity with the laws of the land.

Captain E. G. FISHBOURNE, R.N. C.B. Chairman of the COUNCIL—

Perhaps the hon. gentleman will make a substantive proposition on the subject. He made a proposition last year, but there was nobody to second it.

Lieutenant GARDINER—

I will move then, "That a Committee of not less than five Members be appointed to draw up the heads for the proposed bye-laws; and that the same be submitted to counsel, to see that they are in conformity with the Charter."

Captain FISHBOURNE—

It does not appear from the Charter, that it is necessary to attach the seal to the bye-laws. Certainly, the wording of the Charter does not imply it, whatever may be the usage. It strikes me that our legal adviser would have advised us, if it had been necessary to proceed as Lieut. Gardiner proposes. It says, "That the said General Meeting shall from time to time make and establish such bye-laws, and vary, and alter, and revoke the same, as they shall deem to be useful and necessary for the election of President, Vice-Presidents, and Council, and for the regulation of the said body politic and corporate, for the admission and expulsion of Members, and of honorary and foreign Members; so that such bye-laws be not repugnant to these presents, or to the laws and statutes of this our realm; and shall and may also enter into any resolution, and make any regulation, respecting the affairs of the said body politic and corporate, that may be necessary and proper, and shall not be repugnant to these presents or to the said laws and statutes." It is to be presumed, and we know it to be a fact, that the Charter is granted by the legal advisers of the Crown. They would not grant it, if it contained any provision that is contrary to the laws of the land. We are not in the least responsible for the Charter. The fact that it is granted by the legal advisers of the Crown, is a substantial proof to us that it does not contain anything contrary to the laws of the land.

The DUKE of SOMERSET—

Does any one second this amendment?

Vice-Admiral J. N. TAYLER, C.B.—

I do not rise to second the amendment; but I think if one of the COUNCIL, who is well acquainted with everything that is going on, would second it, it might prevent disputes arising, and you would be carrying out the Charter in a regular form, and avoiding the rocks and shoals that we may be likely to split upon.

Lieutenant-General FOX—

I do not see why the COUNCIL should be called upon to second that in which they do not agree.

Vice-Admiral TAYLER—

If they do not agree in it, of course the responsibility falls upon them.

Colonel the Hon. JAMES LINDSAY, M.P. Vice-Chairman of the COUNCIL—

There is this to be said: if the COUNCIL were in error, twelve months have elapsed since the last Meeting, and it has been perfectly competent for Lieut. Gardiner, in a friendly manner, to go to the Secretary or to our Lawyer—and he was invited to do so—to state what his views were. We are only anxious to pass such laws as would be not only binding upon this Institution, but agreeable to all the Members. He might have come down here in a friendly way at any period within the last twelve months, or

he might at the same time have expressed his opinions, according to the laws, fourteen days ago, by putting up a notice in the Library and Reading Room, to say that he was going to bring such a question forward. That opportunity was not taken by Lieut. Gardiner. I apprehend that the question now before the Meeting is, whether the Report shall be printed and circulated; and if Lieut. Gardiner thinks the bye-laws should be referred to a Committee, he has power by the law to get a certain specified number of signatures for the purpose of calling a Special Meeting and taking that subject into consideration.

Lieutenant GARDINER—

I perfectly ignore the bye-laws as being illegal, not having the common seal o. the Corporation affixed thereto. (Cries of "Spoke! spoke!")

General Sir CHARLES PASLEY, K.C.B. R.E.—

May I be allowed to say a word? This gentleman, in the authority he quoted, speaks of the COUNCIL as an invisible body. I see the Members here before me: then, how can they be invisible? And as to seals, I have been reading lately the "Lives of the Lord Chancellors," and of the Lords Chief Justices, and I find that in early times the nobility and the gentry who had to make the laws could not write, therefore they had great seals. But what use the seal is in the present day I cannot tell. I think the gentleman's objections are perfectly futile, and not to be maintained; and therefore I put a complete negative upon them, as far as my opinion goes.

Lieutenant GARDINER—

Before your Grace puts the resolution, there are some items in the account that I object to. There are annuities here which are not allowable. There is an annuity here of £20, which I think is not allowable; and in going through the accounts, I find a sum appropriated to the printing of the Journal. I am one of the original Subscribers, and we were told that the Journal was not to throw any expense upon the Members, other than those who chose to subscribe to it. Now, I find there is a sum of £175 taken from the General Fund of the Institution to publish the Journal. And there is more than that; I find the whole of the Life Subscriptions and the two Bequests which have been given have not been wholly invested: the sums received for Life Subscriptions and Legacies amount to £1,274; the invested money amounts to £1,153, leaving a balance of £121 unaccounted for. The balance stated by the account is £177 19*s.* 10*d.*; I make a balance of only £57 0*s.* 11*d.* I think these points require some explanation.

Colonel LINDSAY—

The amount of the Legacies, though they appear to be £500 a-piece, we do not get, because there is the succession duty and income-tax to be paid.

Lieutenant GARDINER—

I have only taken the two Legacies at £876.

Colonel LINDSAY—

All I can tell the hon. gentleman is, that we have invested every item of Life Subscriptions that we have received, and also the Legacies. The amount of Life Subscriptions is not caused by new Life Subscribers altogether, but by a great many additions to the original Life Subscriptions; the increased Life Subscriptions being £3 added to the original £6, that £3 being the composition for those who wish to have the Journal. With regard to the Journal, the amount expended last year upon it was £589; we have 1,155 Members who have increased their subscriptions to £1 and upwards; we have 182 Life Members who have given the increased composition in order to receive the Journal; we have 49 Life Members, who, instead of giving an increased composition, pay an extra annual sum of 10*s.* Taking the half of 1,155, and

the half of 49 Members who pay the increased subscription, that brings it up to £602 a year towards the Journal; and the increased Life Subcriptions from the above 182 Members, amounting to £546, divided over a period of 12 years, will leave £45 to be added to the £602 towards the Journal, making a grand total of £647, whilst the gross expense of its publication last year was £589, so that we have actually received more than it costs in publication. Besides that, the Government gives us a sum of money every year for the purpose of increasing the scientific character of this Institution. I apprehend that, with the Lectures given in this Theatre, the publication of the Journal, and its circulation to all parts of the world, in propagating science by means of the Lectures here, conveying it to our officers abroad, and letting them know what we are doing at home, we are carrying out the intention of the Government; and a portion of the sum of money which we receive from them properly goes to the account of the Journal; consequently, so far from the original Members paying for its publication, the Journal is actually self-supporting.

The Resolution was then put to the Meeting, and carried.

V. The names of eight Members retiring from the COUNCIL by rotation were read:—

Captain RYDER, R.N.	Captain PACKE.
Major COOKE, R.E.	Captain FISHBOURNE, R.N., C.B.
Lieut.-Colonel STUART, M.P.	Captain JEFFERSON.
Captain COLLINSON, R.N. C.B.	Captain Sir SIBBALD SCOTT, Bart.

VI. Colonel HART—

I beg leave to propose:

"That the thanks of this Meeting be given to the Members of the COUNCIL who retire by rotation, and that the following Members be elected to fill the vacancies":—

Captain COLLINSON, R.N., C.B.	For Re-election.	Captain BARNETT, R.N.
Captain FISHBOURNE, R.N., C.B.		Lieut.-Colonel FLETCHER, Sco. Fus. Gds.
Captain JEFFERSON, late Ceylon Rifles.		Colonel ADAIR, Suffolk Mil. Art.
Captain HOUSTON, R.N.		Captain HALSTED, R.N.

B. OLIVEIRA, Esq.—

I have the honour to second that resolution, and in doing so, I may take the liberty of observing, that when travelling in the Mediterranean I have had occasion to remark that the publications of the Institution are of great utility. I have frequently seen them at the different messes at Malta and Gibraltar with great satisfaction, and I think I may venture to say that the circulation of the Journal has induced a great number of officers to join the Institution.

The Resolution was put from the Chair and carried unanimously.

VII. Lieutenant-Colonel MAN—

My Lord Duke, I have the pleasure of proposing,

"That the thanks of this Meeting be given to the Auditors for their valuable services, and that the following gentlemen be elected for the ensuing year:—

HENRY ELLIOT, Esq.	Captain J. E. A. DOLBY.
THOMAS SMITH, Esq.	M. F. DOWNES, Esq."

Major PORTER, R.E.—

Having been requested to second this resolution, I intended to have done so without troubling the Meeting with any observations; but after the discussion which has just taken place, perhaps it will be right for me to state, that I have been appointed the Official Member of the COUNCIL by the Secretary-at-War to report upon the Institution, in order that his Lordship may be guided as regards the future grants to be

given to it. I have every reason to hope, that my report on the next occasion will be satisfactory, and I think it will be well for me to state, that I shall dwell with considerable satisfaction upon the Journal, as being one of the most valuable instruments which the Institution possesses, for circulating a knowledge of naval and military science amongst those of our Members who are obliged by professional duties to be absent, not only from London, but from the country.

The Resolution was put from the Chair and carried unanimously.

VIII. Colonel LINDSAY—

I have to move an Amendment in the Laws, notice of which has been duly posted in the Reading Room. Section V. paragraph 3, runs thus:—

"The funds of the Institution, and all Life Subscriptions and Legacies shall be invested in eligible securities in the names of Trustees, selected by the COUNCIL, with the approbation and concurrence of a General Meeting."

That is the law as it at present stands. After the Charter had been granted, it was ascertained that was it not necessary to have Trustees, and that it would cause considerable inconvenience: it was found that other bodies who had received a Charter of Incorporation had their funds invested in the general body of the members, through the agency of the charter and its seal; consequently, trustees are an inconvenience, for the moment a Trustee dies you have to find another to supply his place. There is considerable expense attending that transaction. Therefore we propose, in lieu of the section, as it stands, to substitute the following:—

"That the funds of the Institution, and all Life Subscriptions and Legacies, shall be invested in the name of the Corporation in eligible securities, to be selected by the COUNCIL."

I have also another Amendment to propose in Section VIII. which runs thus:—

"Should it be proposed to make or repeal a bye-law," &c.

I propose to insert the word "amend," so that it will read:—

"Should it be proposed to make, *amend*, or repeal a bye-law," &c.

W. S. LACON, Esq.—

I beg to second that motion.

Major-General BOILEAU—

I would wish to make an observation with reference to the second of these propositions, not with any intention of objecting to it, but to suggest a word which, I think, would be more appropriate to the object which Colonel Lindsay has in view. I would suggest that the word "alter" would be a better word than "amend," because "amend" has a specific meaning—to "improve." The object is to alter, I have no doubt; but, with regard to an improvement, that may lead to discussion. Having had a great deal to do with committees in my time, I think the term usually used is "alter," and not "amend." If not objectionable, I think that would be the better word.

Colonel LINDSAY—

I have no objection to take the word "alter," so that it will read, "make, alter, or repeal any bye-law."

The Resolution was put from the Chair and carried unanimously.

IX. Colonel P. J. YORKE, F.R.S. Vice-President—

The resolution which I hold in my hand is to this effect: "That, in accordance with a notice suspended for fourteen days in the Reading Room, this Meeting do authorise the COUNCIL to dispose of such Chinese and Indian curiosities, together with Roman and other antiquities as are not of naval or military interest." This resolution becomes necessary, in order to carry out the views already adopted by the General Meeting last year, and in accordance with some change lately made in the design of this Institution. At the commencement of this Institution, the Members who took a leading part in found-

ing it did not limit it to the objects that we now find it necessary to do. In the early days of the Institution, it was attempted to make collections here of all kinds. We had collections of natural history, of antiquities, and of various other objects; but in progress of time that was found to be impossible, because no place would hold all the objects that came in; and from the number of other Museums and public Institutions in the metropolis, it was thought it would be much more advantageous to give the Institution a more specific character, and to limit it entirely, or nearly so, to objects that had some naval or military interest. It is in accordance with that view that I now submit this resolution to the Meeting. The purpose of it, is to give the COUNCIL an opportunity to dispose of such of these curiosities as are not of professional interest. The COUNCIL do not propose to do this in a hurried manner; they propose to consult, as far as possible, the wishes of the donors. Some of the objects are of considerable value and interest; and the intention is, that they may be disposed of in the way that may be most agreeable to the donors.

Lieutenant-Colonel LE COUTEUR, Coldstream Guards—

I beg to second this motion.

Lieutenant-General FOX—

Having been absent, in consequence of illness, I am not aware whether this point has been discussed in the COUNCIL; but I should like to know whether the objects named in this Resolution include the ancient Greek and Roman coins, which I should be very sorry to see sold. It is a great object for numismatic science, that officers should collect coins when they are abroad, and give them to the Museum; and, as they occupy very little space, I do not think they should be disposed of.

Colonel YORKE—

It is not intended to dispose of them.

Colonel LINDSAY—

The coins are in the Library.

Sir CHARLES PASLEY—

By permission of the President, it strikes me that the donors of any curiosities should always be consulted as to the disposal of them. Thinking it would be for the benefit of science, I gave a number of philosophical instruments, a copy of the Transactions of the Royal Society, and the East India Registers, to the Scientific Institution formed at Chatham. Well, they sold them. I would willingly have paid the whole value of the things, to have had them again. I was deprived of that opportunity, and I feel it would be rather a hardship if the donors to this Institution were to be treated in the same way.

Rear-Admiral Sir G. LAMBERT, K.C.B.—

I beg to state, that, having been a donor to this Institution, as regards a great many cases of natural history—birds, and things of that sort—I did have that compliment paid to me when they were disposed of, and I feel quite sure that nothing will be disposed of without taking into consideration the wishes of the donors.

The Resolution was then put from the Chair and carried unanimously.

The CHAIRMAN announced that the business of the Meeting was concluded.

(Signed) SOMERSET,
Chairman.
B. BURGESS, Captain,
Secretary.

Captain FISHBOURNE—

I have the pleasure of moving that General Fox do take the Chair.

Lieutenant-General Fox accordingly took the Chair.

Colonel A. SHAFTO ADAIR—

In rising to propose the Resolution with which I have been entrusted, I am sure I may infer that it will meet with the cordial support and sympathy of all officers here present. It is a great satisfaction to us to find, that the efforts made by the officers of the United Services to promote the scientific knowledge and development of all that concerns the efficiency of both, is recognised by those who are not immediately connected with us. It is still a greater satisfaction to find that those who are placed by the Constitution of our country at the civil head of these two great Services, honour us with their presence on these occasions. Therefore it is, and I am sure I shall have been anticipated in the Resolution, that I propose the thanks of this Meeting to the First Lord of the Admiralty, who has honoured us by presiding on this occasion. I think it is of especial advantage at this moment, when in the great department of the public service over which he presides, as well as in that of the sister Service, experiments are being made, which will lead, I trust, to but one conclusion—the preservation unabated, of the supremacy of Her Majesty's forces by land and sea as it has been hitherto. Perhaps I may be permitted at this moment to refer to that special department over which the noble Duke presides It has set an example of exceeding value, in not limiting the experiments which are designed to improve the fitting, the form, the speed, the capacity, and armaments of our vessels, to the royal dockyards alone, but in drawing information from any quarter from which it may be obtained. Therefore, feeling it perfectly unnecessary to dilate on the merits of that department, which are recognised by all, I will conclude by moving, "That the thanks of this Meeting be given to His Grace the Duke of Somerset, for his kindness in presiding in the Chair on this occasion."

Sir GEORGE LAMBERT—

I have great pleasure in seconding the Resolution. I am quite convinced that nothing can be more serviceable to this Institution than to be supported by the heads of departments. They give a tone to the Meetings by their presence, and enable us to look forward to the carrying out of the advantages to be derived from the information that is constantly being laid before the public by this Institution. I trust on future occasions we shall find the same good feeling existing which has been shown to-day, and that no impediments will be thrown in the way of promoting the objects of the Institution.

The CHAIRMAN—

I feel greatly honoured in being called upon to take the Chair in order to give the unanimous thanks of this Meeting to my old friend the Duke of Somerset, who fills office, I believe, with the most perfect satisfaction to the Service over which he presides, and who has given up time which is so valuable elsewhere, that he may come down here and assist us in the objects of our Institution.

The Resolution was put to the Meeting and carried with acclamation.

The Duke of SOMERSET—

GENERAL FOX and GENTLEMEN,—I have come here to-day because I take great interest in this Institution, and because I believe the public interest in it will spread more and more as time advances. Every day we observe the progress that science is making, and the practical application of science to both naval and military purposes; and, as this goes on, the value of this Institution must be more generally known. In the first place, I may congratulate you upon the financial statement we have heard to-day. It shows that you are in a sound financial condition, and I only hope that other financial state-

ments made elsewhere will be equally satisfactory. With regard to the Museum, I think you have done wisely in limiting it to the special purposes for which it ought to be maintained. I have had great experience in museums, from the British Museum downwards. The great danger and difficulty in all museums is the tendency to bring in and accumulate things that are not really wanted. When gifts are offered, the difficulty is to exclude them. First, one thing is given, in some way connected with the objects of the collection, though not strictly so, and then another, until at last the whole museum becomes a confused heap; you cannot conveniently find what you may be looking for, and there is no room left for what is really desirable. I was connected with the Museum of Practical Geology in Jermyn-street when it was first started, and the arrangement we made with Sir Henry de la Beche was, that it should be strictly confined to the one object for which it was established, but we had the greatest difficulty in carrying the rule out. The resolution you have passed to-day upon the subject of your Museum appears to me a wise one. With regard to lectures, I observe the COUNCIL express their regret that they have been unable to obtain a lecture containing a complete *résumé* of the progress of military and naval science during the past year. I am not surprised at that, when I look at the progress naval and military science has made during the year. I am not surprised that no one will take upon himself to lay it all down exactly in a lecture here. It will be a very difficult task to undertake, at least unless a person had more presumption than I should think any Member of this Institution has. At the same time, I may say it is of the greatest value to have an Institution of this kind, where lectures on naval and military science are given, because a great deal of information might otherwise be lost. I know, in regard to the Navy, a great many things are discovered, and are put aside for the want of a proper place to preserve them. Many years afterwards, what are thought to be discoveries are made, and we often find, if we had looked back and consulted our papers, that the discoveries had been made a long time ago. That is continually occurring, and it shows of what great advantage an institution of this kind may be, in recording information of this character and communicating it throughout the Services. It may save other people a great deal of time, for, if they are pursuing any particular study, they know where to go and how to look for it. As regards the particular pursuits to which we are directing the minds of both Services, so many questions present themselves, that they can only just be touched upon. For instance, there is the whole question of gunnery, cannon, and projectiles. During the past year experiments have been tried. Every day new information comes. It was but two days ago I received an interesting report from Prussia upon the subject of their trials. We have such a variety of information upon this subject, that it is most desirable these trials should be carefully watched and followed out. If any one has energy enough to extend his inquiries still further, there is the whole question of the defence of the country, upon which there still exists a great variety of opinion. If I look back to the opinions prevailing eighteen months ago, I find that those opinions are already very much modified. Then, again, we come to the great question of iron or wooden ships. What strikes me with regard to this question—indeed, with regard to many other scientific questions—is, that they should be taken up in a philosophical spirit, instead of being taken up, as they too often are, in a very bitter sectarian spirit. They are treated as if it was a question of theology. You have the advocates of wood on the one side, and the advocates of iron on the other, calling each other names, as if scepticism was a crime and doubt a deadly sin. Now, I think the fair way, as they are philosophical questions, is to deal with them in a philosophical spirit. Let us ascertain what is best to be done in these questions. They are not easy of solution. It is only by treating them as a matter of faith that you make them easy. If you adopt as a matter of faith that So-and-So is quite right, and that whoever says to the contrary has a bad motive and is a dishonest fellow, why, you may settle the question easily in your own mind, but you do not settle it to the interest of the country. What we have to do is to look at these questions calmly in all their bearings; and I am sure if that were done we should then arrive at a satisfactory result. With respect to this very question of iron, for instance, lately the Government appointed a commission to examine the question of the quality of iron; because, when we came to test these experiments on iron, the first thing I asked was, "What do you call iron?" "Well," was the reply, "everybody knows what iron is." But when I sent for a person who does know something about it, Dr. Percy, of the Museum of Practical Geology, he informed me of the very great difficulties there were in the question, and he said we should

find there were many sorts of iron, possessing different degrees of resistance, and that the question required to be looked into. I remember, when I was in the office of Commissioner of Works, we were putting up the bronzes on the Nelson monument in Trafalgar Square. When I went into the office I was told they were going to order another of these bronzes. I asked if they had entered into the contract, and I was told the late Government had made the contract. I asked if they knew it was really bronze; I said, "Supposing the proper mixture is not made—suppose a bad metal is put in, have we any legal remedy?" "No," they said, "the contract is worded in such a manner, that, if you do not get good metal put into the mould, you must have what they choose to give you: you are at the mercy of the trade." That arose from the want of a little practical knowledge of the subject. Now, I conceive an Institution like this will be of great use in directing attention to matters of that kind which more particularly affect the naval and military professions. I have come here with an earnest desire to see this Institution advance, and to urge upon you, whenever experiments are going on, to procure records of them, and to ascertain that they have been fully and fairly tried. I am sure you will take in good spirit the suggestion I have thrown out, and I beg to thank you very sincerely for the honour you have done me.

Statement of Changes among the Members since 1st January, 1860:—

	Life.		Annual.		Total.
Number of Members on 1st January, 1860 .	831	+	2513	=	3344
Do. who have joined during 1860 .	23		277		300
	854		2790		3644
Changed from Annual to Life . . .	+ 7		— 7		
	861		2783		3644
	Life.	Annual.			
Deduct—Deaths during 1860 .	28	70			
Withdrawals . . .		15			
Struck off . . .		13			
	28		98		126
Number of Members on 1st January, 1861.. Total	833		2685		3518

TABULAR ANALYSIS OF THE STATE OF THE INSTITUTION, To the 31st of December, 1860.

Year. 1st Jan. to 31st Dec.	Annual Subs. received.	Entrance Fees.	Income (from all sources).*	Life Subs. received.	Amount of Stock.	Invested in the purchase of Books, &c.	No. of Vols. in Library.	No. of Members on the 31st Dec.	Number of Visitors.
	£	£	£	£	£	£			
1831	654	..	654	1,194	..	..	..	1,437	..
1832	1,146	..	1,146	973	..	..	..	2,699	..
1833	1,405	..	1,450	692	..	..	..	3,341	..
1834	1,500	..	1,549	583	1,100	..	..	3,748	13,376
1835	1,480	..	1,574	366	2,430	40	..	4,155	8,537
1836	1,570	..	1,682	330	3,747	45	..	4,069	8,521
1837	1,549	..	1,747	222	4,747	180	..	4,164	10,907
1838	1,462	..	1,634	230	5,500	246	..	4,175	15,788
1839	1,399	..	1,565	168	5,500	292	..	4,186	16,248
1840	1,363	..	1,525	198	5,500	446	5,500	4,257	17,120
1841	1,450	..	1,643	186	6,000	243	5,850	4,243	19,421
1842	1,373	..	1,565	144	6,400	373	6,450	4,127	21,552
1843	1,299	..	1,494	140	6,700	237	7,000	4,078	27,056
1844	1,274	..	1,408	112	3,000	298	7,850	3,968	22,767
1845	1,313	..	1,466	228	1,500	127	8,100	3,988	21,627
1846	1,298	..	1,456	138	1,500	74	8,410	4,031	32,885
1847	1,314	74	1,502	132	1,700	37	..	4,017	38,699
1848	1,175	57	1,375	48	1,700	85	9,641	3,947	37,140
1849	1,176	72	1,375	84	1,150	58	..	3,970	33,333
1850	1,141	106	1,294	198	600	36	..	3,998	33,773
1851	1,136	131	1,292	66	666	34	10,150	3,188	52,173
1852	1,134	133	1,281	114	200	43	10,300	3,078	20,609
1853	1,243	319	1,684	264	528	41	10,420	3,251	25,952
1854	1,200	138	1,368	126	612	95	10,587	3,171	22,661
1855	1,159	107	1,289	120	653	55	10,780	3,131	14,778
1856	1,216	197	1,519	156	761	47	10,832	3,204	16,184
1857	1,258	176	1,937	78	1,038	40	10,960	3,168	12,755
1858	1,318	221	2,102	105	438	31	11,062	3,246	25,747
1859	1,526	195	2,277	512	946	70	11,320	3,344	28,739
1860	1,961	298	3,577	397	2,178	114	11,517	3,518	28,011

* Including Annual Subscriptions, Entrance Fees, Donations, Legacies, and Interest on Funded Property; and also the grant from Government, commencing in 1857.

LIST OF DONATIONS

From 1st January to 31st December, 1860.

	£	s.	d.
Carter, W. G., F.S.A., *Esq.* Solicitor Sco. Fus. Gds.	1	1	0
Cautley, *Sir* Proby T. Col. ret. Bengal Army	2	0	0
Vyvyan, R. H. S. Lieut. Duke of Cornwall's Rang.	1	1	0
Carried forward	£4	2	0
Brought forward	4	2	0
West, *Sir* John, G.C.B. Admiral of the Fleet	5	0	0
Pollard, J. P. *Esq.* late Audit Office	3	0	0
Mundy, G. V. Col. 19th Regt.	2	0	0
Total . .	£14	2	0

LIST OF NEW MEMBERS

WHO JOINED THE INSTITUTION SINCE THE LAST EVENING MEETING IN 1860 (JUNE 4TH).

LIFE MEMBERS.

Arrow, W. G., Major H.M. 28th Bombay N.I.
Brown, Jno., late Mid. H.E.I.C.SS.
Blundell, H. B. H., Lieut. Rifle Brigade.
Charlewood, E. P., Capt. R.N.
Collings, J. E., Lieut.-Col. 33rd Regt.
Chichester, Hon. G. C., Lt.-Col. 77th Regt.
Dyer, S. H., Capt. 8th King's.
Hincks, A. S., Ens. 3rd W.I. Regt.
Halsey, H. W. R. W., Deputy-Lieut. Sussex
Hope, W., *CB.*, Lt.-Col. 71st Highlndrs.
Herbert, Hon. A. W. E. M., Lieut. 7th Hussars.
Jones, H. M., Major 73rd Regt.
Lennox, W. O., Lt.-Col. R.E.
Paynter, J. A., Capt. R.N.
Stanley, *the Right Hon. Lord, M.P., P.C.*
Taylor, W., Capt. Mid. Rifle Vol.

ANNUAL SUBSCRIBERS.

Adair, H. A., Lieut. 52nd Regt.
Alston, W. E. *M.D.*, Staff Assist. Surg.
Anstruther, P. R., Lieut. 94th Regt.
Ashford, H. W., Ens. 100th Regt.
Aufrere, G., Capt. late 20th Lt. Dgs.
Aylmer, J. E. F., Lieut. 8th King's.
Aytoun, J. Capt. 7th Hussars.
Baker, Valentine, Lt.-Col. 10th Hussars.
Baldwin, F. C., Ens. Ceylon Rifles.
Banks, C., late Sec. to Kilmainham Hosp.
Bayly, C. J., Governor of the Bahamas
Beere, D., Capt. 8th King's.
Bellamy, P. L., Capt. 55th Regt.
Bellers, R. B., Capt. late 50th Regt.
Bertram, C. P., Bt.-Major 41st Regt.
Blair, J. B., Ens. 6th Regt.
Blane, C. G., Capt. 23rd R. W. Fus.
Blinkhorn, W., Capt. 7th Drag. Gds.
Boom, A. S., Ens. late Roy. Elthorne Mil.
Boyce, A. W., Capt. 34th Regt.
Brabant, E. Y., Ens. Cape Mounted Rifles.
Breen, H. H., Adm. to Gov. of St. Lucia.
Brereton, W., *CB.*, Maj.-Gen. R.A.
Brown, C. B., Lieut. 8th King's.
Buchanan, J. R. G., Ens. 26th Regt.
Budd, R., Lt.-Col. 14th Regt.
Burn, R. D., *M.D.*, Assist. Surg. R.A.
Burton, H. A., Lieut. 14th Regt.
Butler, W. G., Ens. 94th Regt.
Carroll, W. J., Lieut. R.E.
Cleeve, S. A., Capt. 51st Regt.
Cobbe, C., Capt. 13th Lt. Infantry.
Colls, R. S., Major 32nd Regt.
Colthurst, D. L., Major 17th Regt.
Cookesley, A. F., Dy. Com. Gen.
Costin, C., Lieut. and Adjt. 14th Regt.
Cowburn, T. B., Lieut. 52nd Lt. Infantry
Dawes, E. A., Capt. and Adjt. Aberdeen Highlanders.
Decie, R., Lieut. R.E.
De Thoren, O. W., Ens. 45th Regt.
Dewar, A., Capt. late 87th Roy. I. Fusiliers
De Winton, F. W., Capt. R.A.
D'Eye, W. R., Capt. 91st Regt.
Docker, E. S., Staff Surgeon.
Dunlevie, W. T. H., Lieut. 12th Regt.
East, C. J., Lieut. 82nd Regt.
Elliot, A. C., Capt. 94th Regt.
Elliot, F. H., Lieut. 94th Regt.
Ellis, C. H. F., Lieut. R.A.
Eustace, T. F., Lieut. 49th Regt.
Fair, A., Paymaster 17th Depot Batt.
Filgate, T. P. M., Lieut. 18th Hussars.
Fitzgerald, F. A., Capt. 12th Regt.
Fitzgerald, R. P., Lieut. R.N.
Frampton, W. J., Lieut. 7th Roy. Fusiliers.
Gage, *Viscount*, Major late Sussex Mil.
Gale, H. R. H., Capt. Mil. Train.
Gammell, J. H. H., Capt. 9th Regt.
Gardiner, R., Col. I. F. Officer, Cork.
Gardiner, T., Lieut. 98th Regt.
Gibbons, T., Surgeon 95th Regt.
Glover, F. G. E., Lieut. 43rd Lt. Infantry
Godbold, A. B., Lieut. 1st R. Surrey Mil.
Goepel, P. D., Lieut. Hon. A. Compy.
Grahame, Geo. Quar.-Master 21st Royal N. B. Fus.
Grant, G. F., Lieut. 62nd Regt.
Granville, B., Major 23rd R. W. Fusiliers.
Grogan, C. E., Capt. 14th Regt.
Gubbings, T., Lt.-Col. 2nd W. I. Regt.
Gubbins, J., Major 23rd R. W. Fus.
Haig, J. F., Lieut. 90th Lt. Infantry
Hamilton, L. H., Major 87th R. I. Fus.

Harnett, E., Capt. 11th Hussars.
Harrison, W. A., As. Sur. Hants Mil. Art.
Harvey, C. L., Lieut. 91st Regt.
Henslowe, S. V. F., Capt. 73rd Regt.
Holt, A., Capt. 21st R. N. B. Fus.
Holt, J., Capt. H. M. 20th Bombay N. I.
Hooke, H. H., Ens. 45th Regt.
Hosier, H. M., Lieut. R.A.
Hutchinson, H. M. L., Ens. 14th Regt.
Ingles, *Sir* Jno., Major-Gen., K.C.B.
Isacke, R. J., Lieut. 71st Highland Lt. In.
Jervis, E. S., Lieut. H. M. 2nd Bom. Eu. Lt. Infantry.
Johnson, J. O., Lieut. 12th Regt.
Jones, E. M., Capt. 20th Regt.
Kempt, J. F., Lt.-Col. 12th Regt.
Kerr, *Lord* R. D., Lieut. and Adjt. 10th Hus.
King, G. S., *M.D.*, Surg. 14th Regt.
Lacy, G. de Lacy, Lieut. 12th Regt.
Laing, J., Lieut. 14th Regt.
Lambert, F.W., Major H. M. 56th Bengal N. I.
Lamont, J., Dep.-Lieut. Bute.
Lawrie, J. D., Lieut. 34th Regt.
Lawson, B., Major R.A.
Leach, J. G., *M.B.*, As. Surg. 94th Regt.
Leeson, C. E., Lieut. 34th Regt.
Leeson, R. J. P., Lieut. and Adjt. 34th Regt.
Le Mesurier, A. A., Capt. 14th Regt.
Levinge, *Sir* R., Bart., *M.P.*, Lt.-Col. late Westmeath Rifles.
Lewis, R., Lieut. 71st Highland Lt. In.
Lockhart, A. E., Lieut. R.E.
Lodge, W. R., Lieut. (h. p.) H. M. Indian Army
Loraine, *Sir* Lambert, Bart. Lieut. R.N.
Macauley, G.W., Capt.Com. Scinde Horse.
MacDonnell, H. I., Ens. 12th Regt.
MacDonnell, W., Capt. and Paymaster 14th Regt.
McGoun, T., Lieut. 43rd Light Infantry
Mackenzie, J. D., Capt. 14th Regt.
Mackenzie, *Sir* Wm. Dy. Lieut. Ross-shire
Mackinlay, J., Lieut. 94th Regt.
Mackinnon, W. A., Staff Surgeon.
Madden, W. W., Lieut. 8th King's.
Malthus, S., Lieut. 94th Regt.
Mapleton, H., *M.D.*, Dep. Insp. Gen. of of Hosps.
Maurice, R. M. B., Capt. 95th Regt.
Mathew, W. H., Lieut. 85th Lt. Infantry
Matthews, F. P., 1st Sussex Rifle Vol.
May, Allen, Lieut. R.E.
Mends, W. R., Capt. R.N.
Moore, F. G. F., Lieut. 8th King's.
Moore, J. L., Capt. 34th Regt.
Nangle, H., Capt. 15th Regt.
O'Brien, J. T. N., Major 20th Regt.
Palmer, J., Capt. R.N.
Peacocke, T. J., Capt. 94th Regt.
Peddie, C., Capt. 21st R. N. B. Fus.
Pilkington, J. B., Lieut. 94th Regt.
Pitman, F., Acting Paymaster, R.N.
Pote, C. St. Clair, Ens. Cape M. Rifles.
Powell, R. A., Capt. R.N., *CB.*
Ratcliff, C., Capt. 1st Warwick Rifle Vol.
Reeve, F., Capt. 73rd Regt.
Reid, A. G., Capt. (ret.) Bengal Army.
Salmon, Charles, Ens. 43rd Regt.
Saunders, F. H., Capt. 34th Regt.
Seaman, W. C., *M.D.*, Surg. 72nd Highl.
Sharp, J. H., Lieut. 17th Sur. Rifle Vol.
Skinner, J. H., Ens. 8th King's.
Smith, J. H., Lieut. R.E.
Spearman, H. R., Lieut. 91st. Regt.
Stapylton, G. G. C., Lt.-Col. 32nd Lt. In.
Staunton, L., Lieut. Hants. Mil. Art.
Stewart, *Sir* Houston, Vice-Admiral, K.C.B.
Stoney, F. S., Lieut. R.A.
Strange, C. J., Major R.A.
Stuart, R., Lieut. 94th Regt.
Styan, A., Capt. Queen's Westm. R. Vol.
Sweny, J. C., Capt. 91st Regt.
Sykes, Rev. W., Chaplain to the Forces.
Tanner, E., Lieut. 8th King's.
Teevan, G. J., Lieut. 94th Regt.
Temple, G. M., Lieut. R.N.
Thomas, H. J., Lt.-Col. (h.p.) R.A.
Thompson, R. T., Lieut. 56th Regt.
Trench, Hon. W. Le Poer, Lieut. R.E.
Turner, J. T., Ens. 73rd Regt.
Twyford, A. F., Ens. 2nd Queen's.
Tyler, E. S., Lieut. R.E.
Wahab, H. J., Capt. and Paymaster 94th Regt.
Ward, J., Lt.-Col. late 91st Regt.
Webb, C. H., Ens. 34th Regt.
Webster, G., Lieut. 16th Lancers.
Wheeley, J. S., Lieut. 8th King's.
Wilkieson, W. H., Capt. 62nd Regt.
Williams, H. A., Ens. 14th Regt.
Windsor-Clive, *Hon.* G. H. Capt. Coldstream Guards.
Winsloe, R. W. C., Lieut. 21st R. N. B. Fus.
Young, T., Capt. 22nd Regt.

ADDITIONS TO THE LIBRARY AND MUSEUM
DURING 1860.

LIBRARY.

BOOKS PRESENTED.

ABRAHALL (Chandos H.) Esq. The Career of Franklin, with other Poems. 1 Vol. small 8vo. London, 1860.
John Barrow, Esq. F.R.S.

ADYE (John) Esq. Addenda to work on the Displacement and Equipment of Ships and Vessels of War. Pamph. 8vo. London, 1859.
John Barrow, Esq. F.R.S.

ADYE (Col. John) R.A. C.B. Artillery in India. Pamph. 8vo. Madras, 1860.
The Author.

ALDERSHOTTANA; or, Chinks in my Hut, and Touch-and-go Sketches from Court to Camp. 1 Vol. 8vo. London, 1859. *Captain Æ. Field.*

ALEXANDER (Lieut.-Col.) C.B. Royal Marine Artillery. The Command of the Channel and the Safety of our Shores. Pamph. 8vo. London, 1860.
The Author.

ANNALS OF THE WARS, 1796. Vol. V. 12mo. London, 1850.
Lieut.-Gen. Hon. Sir. E. Cust, K.C.B.

ARTILLERY, Construction of. Excerpt Minutes of Proceedings of the Institution of Civil Engineers. Vol. XIX. Session, 1859-60. Pamph. 8vo. London, 1860.
The Institution of Civil Engineers.

AVA. Two Years in, from May 1824 to May, 1826. 1 Vol. 8vo. London, 1827.
J. Crawfurd, Esq. F.R.G.S. &c.

BADDELEY (P. F. H.) Esq. Surgeon ret. Bengal Army. Whirlwinds and Dust Storms of India. 1 Vol. 8vo. London, Plates to ditto. 1 Vol. 4to. 1860.
The Author.

BAINBRIGGE (P.) Lieut.-Gen. K.C.B. Mis-statements in the Historical Records of the 20th Regiment. Pamph. 8vo. London, 1860. *The Author.*

BARROW (John) Esq. F.R.S. Captain Cook's Voyages. 1 Vol. 8vo. London, 1860. *The Editor.*

BELLOT (J. R.) Lieut. French Navy. Journal d'un Voyage aux Mers Polaires exécuté à la recherche de Sir John Franklin, en 1851 et 1852. 1 Vol. 8vo. 1854. *John Barrow, Esq. F.R.S.*

BLUE BOOKS:

Report on the Past and Present Condition of Her Majesty's Colonial Possessions and of the Ionian Islands, 1846, 1847, 1848, and 1850.

Report on the Past and Present Condition of Her Majesty's Colonial Possessions, 1850—1852. Part ii. 1852—1857.
The Secretary of State for the Colonies.

Explorations—British North America.

Abstract of the Returns of Wrecks and Casualties which occurred on or near the Coast of the United Kingdom from 1st January to 31st December, 1839.

Papers relative to the Exploration of the Country between Lake Superior and Red River Settlement.

East India Prize Money.

Army Purchase of Commissions.

Marine Engines.

Report of the Council of Military Education, 1860.

East Indies—Extracts of Correspondence relating to Honours or Rewards bestowed on the Native Princes of India. *W. F. Higgins, Esq.*

BOMBAY MAGNETICAL AND METEOROLOGICAL OBSERVATIONS. 1 Vol. 1857.
The Secretary of State for India.

BOSSOLI, CARLO. The War in Italy, with a descriptive Narrative by the Author of the "Times" Letters. 4to. London, 1859.
H. J. B. Hancock, Esq. Ensign 45th Regt.

BRABAZON (L. B.) Capt. R.A. Soldiers and their Sciences. 1 Vol. 8vo. London, 1860 *The Author.*

BRISBANE (Sir Thomas) Bart. Gen., Reminiscences of. 1 Vol. 4to. Edinburgh, 1860. *Anonymously.*

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Maj.-Gen. L. D. Williams.

MISCELLANEOUS.

Part of a Flag of H.M. Ship "Victory," carried in procession at Lord Nelson's funeral, which it was intended should have been lowered into his vault, but was torn up and appropriated by the sailors who carried it.
Captain W. H. Dobbie, R.N.

Flag used by the Crew of His Majesty's Ship "Niger," when they opposed the Mutineers at Sheerness in 1797, and presented by them to their Captain, Edw. James Foote.
Admiral Stanhope, in the name of his Wife.

The Sword used by Lord Nelson when boarding the "San Joseph," off Cape St. Vincent

Vice-Admiral Sir G. R. Lambert, K.C.B.

Pistol and Officer's Dirk, taken out of "L'Intrépide," 74 guns, Captain Enfermé, which struck to the "Orion," Captain Codrington, during the action off Trafalgar.

Capt. Sir Thos. W. Holburne, Bart. R.N.

A Musket recovered in 1859 from the Wreck of "La Lutine" Frigate, 32 guns, Captain Launcelot Skynner, which frigate sailed from Yarmouth Roads for Hamburgh on the morning of the 9th October, 1799; she was lost in a heavy gale the same night, on the outer bank of the Island of Vlieland; with the exception of one man, every soul perished. *Captain Geo. Halsted, R.N.*

Sloop "Little Belt," a portion of.

Mr. J. Mann.

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Harness, H. D. Col. R.E. C.B.

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Blane, S. J. Major 52nd Foot.

Madras.

Governor.

Denison, Sir W. T. Col. R.E. K.C.B.

General Commanding Division.

McCleverty, W. A. Maj.-Gen.

Bombay.

Commander-in-Chief.

Mansfield, Sir W. R. Lieut.-Gen. K.C.B.

Major of Brigade.

Cleeve, S. A. Capt. 51st Foot.

AUSTRALIAN COLONIES.

Melbourne.

Major-General on the Staff.

Pratt, T. S. Maj.-Gen.

Aide-de-Camp.

Forster, B. L. Lieut. R.A.

New South Wales, Sydney.

Major of Brigade.

Heywood, W. Capt. 14th Foot.

Tasmania.

Commanding Royal Engineers.

Broughton, W. E. D. Col.

New Zealand.

Commanding Royal Engineers.

Mould, T. R. Col. R.E.

WEST INDIES.

Commanding Royal Artillery

Domville, J. W. Lieut.-Col. R.A.

Jamaica.

Lieutenant-Governor.

Taylor, Pringle, Maj.-Gen. K.H.

Deputy Adjutant-General.

Reynolds, J. W. Lieut.-Col.

Bahamas.

Governor and Commander-in-Chief.

Bayley, Chas. Jno. Esq.

Barbadoes.

Assistant Military Secretary.

Parish, Major H. W. 45th Foot.

Deputy Adjutant-General.

Hill, E. R. Col.

Commanding Royal Engineers.

Fanshawe, Chas. Lieut.-Col. R.E.

Saint Lucia.

Administering the Government.

Breen, H. H. Esq.

Dominica.

Lieutenant-Governor.

Ord, H. St. George, Lieut.-Col. R.E.

NORTH AMERICA.

Montreal.

Commanding Division.

Williams, Sir F. Bart. K.C.B. Lieut.-Gen. R.A.

Assistant Adjutant-General.

Conolly, J. Lieut.-Col.

Deputy Quartermaster-General.

Napier, G. T. C. C.B. Col.

Commanding Royal Artillery.

Eardley, Wilmot, F. M. Col. R.A.

Nova Scotia.

Aide-de-Camp.

Stapleton, F. G.

Major-General Commanding.

Trollope, C.

Aide-de-Camp.

Armstrong, C. Capt. 16th Foot.

British Columbia.

Lieutenant-Governor.

Moody, R. C. Col. R.E.

Malta.

Deputy Quartermaster-General.

Hallewell, E. G. Col.

Commanding Royal Artillery.

Warde, E. C. C.B. Col. R.A.

Major of Brigade.

Wilson, S. W. F. Capt. 55th Regt.

Gibraltar.

Governor and Commander-in-Chief.

Codrington, Sir W. J. Lieut.-Gen. K.C.B.

Assistant Military Secretary.

Freemantle, A. J. Lieut.-Col. Colds. Gds.

Aide-de-Camp.

Campbell, Hon. H. W. Capt. Colds. Gds.

Colonel on the Staff.

Stehelin, B. S. Col. R.E.

Assistant Adjutant-General.

Lacy, T. E. Col.

Ionian Islands.

Lord High Commissioner.

Storks, Sir H. Col. K.C.B. G.C.M.G.

Aide-de-Camp.

Ponsonby, A. E. V. Capt. Gren. Gds.

Commanding Royal Artillery.

Irving, A. C B. Col. R.A.

Cape of Good Hope.

Governor and Commander-in-Chief.

Grey, Sir George, K.C.B.

Lieutenant-Governor.

Wynyard, R. H. Lieut.-Gen. C.B.

Military Secretary.

Shipley, W. D. Capt. 58th Foot.

Colonel on the Staff.

D'Urban, W. J. Col.

Assistant Adjutant-General.

Fellowes, E. Major.

Commandants.

Freese, J. N. A. C.B. Col. R.A.
Staunton, G. Col. Cape M. Rifles.
Cobbe, C. P. Capt. 13th Foot.

Garrison Adjutant.

Gould, T. T. Lieut. 13th Foot.

WESTERN COAST OF AFRICA.

Sierra Leone.

Captain-General, and Governor-in-Chief.

Hill, S. J. Col. C.B.

Mauritius.

Major-General on the Staff.

Breton, H. W. Maj.-Gen.

Deputy Quartermaster-General.

Johnson, H. F. F. Lieut.-Col.

Commanding Royal Artillery.

Cockburn, C. V. Col. R.A.

Commanding Royal Engineers.

Burgmann, G. Col. R.E.

Ceylon.

Major-General Commanding.

O'Brien, Terence.

Assistant Quartermaster-General.

Ouvry, H. A. Lieut.-Col. C.B.

China and Hong Kong.

Commanding Division.

Michel, Sir J. Maj.-Gen. K.C.B.

Brigadier-Generals of Artillery.

Crofton, E. W. R.A. c.
Crawford, W. T. R.A. C.B. c.

Deputy Adjutant-General.

Stephenson, F.C.A. Lieut.-Col. C.B.

Deputy Quartermaster General.

Mackenzie, K. D. Lieut.-Col.

Deputy Assistant Quartermaster-General.

Brabazon, L. B. Capt. R.A.

Knights of Windsor.

Moore, C. Major
Angelo, E. A. Col. K.H.
King, J. D. Capt.

H.M. Body Guard of Yeomen of the Guard.

Captain Commanding.

Ducie, Earl.

Lieutenant.

Philipps, Sir B. T. Maj.-Gen. late Indian Army.

Exon.

Kincaid, Sir John.

H.M. Body Guard of the Hon. Corps of Gentlemen-at-Arms.

Captain.

Foley, Rt. Hon. Lord.

Standard Bearer.

Harmar, D. J. Esq.

Gentlemen-at-Arms.

Goodwin, E. Esq.
Sutherland, E. Esq.
Middleton, W. H. Esq.
Philips, N. G. Esq.
Deane, E. P. Esq.
Vyvyan, R. H. S. Esq.

1st Life Guards.

Colonel.

Combermere, Stapleton Viscount, Field-Marshal, G.C.B. G.C.H.

Lieutenant-Colonel and Colonel.

Parker, Richard.

Major and Lieutenant-Colonel.

De Ros, Hon. D. C. FitzGerald.

Captains.

Mountcharles, G. H. Earl of.
Elmley, Henry Viscount.
Bateson, Richard H.
Wyndham, Hon. Henry.
Peyton, Algernon W.
Fraser, Jas. Keith.
Grosvenor, Hon. Robt. W.
Bruce, Lord Charles W. B.

Lieutenants.

Duncombe, Hon. Cecil.
Powerscourt, M. W. Viscount.
Patten, E. J. Wilson.
Egerton, Hon. S. J. G.
Biddulph, Richard M.
North, Hon. W. H. J.
Duncombe, C. W.
Earlsfort, J. H. R. Lord.

Cornet and Sub-Lieutenant.

Heneage, Edward.

2nd Life Guards.

Colonel.

Seaton, John Lord, Field-Marshal, G.C.B. G.C.M. G.G.C.H.

Lieutenant-Colonel.

Martyn, F. M. c.

Major and Lieutenant-Colonel.

Vyse, G. Howard.

Captains.

Ogilvy, Thos. c.
Palmer, Roger.
Berkeley, E. S. Fitzharding.

Lieutenants.

Woodgate, Francis.
Cuninghame, J. W. H.
Leyland, Thomas.
Ewart, Henry P.

Assistant-Surgeon.

Buckland, F. T.

Royal Horse Guards.

Colonel.

Gough, Hugh Viscount, General, K.P. G.C.B.

Major.

Baillie, Hugh Smith. l, c.

Captains.

Manners, Lord Geo. J. m.
Sheffield, Robt.
Baillie, Duncan Jas.
Leslie Thomas.
Williams, Bulkeley R. M. L.
Williams, O. L. C.
Hartopp, W. W.
Peach, H. Peach K.

Lieutenants.

Hill, Hon. Geoffroy, R. C.
Garlies, Alan P. Lord.
Carew, Walter P.
Bennet, Philip.
Adderley, M. B. B.
Martyn, Cecil E.

Surgeon.

Logie, Cosmo G. M.D.

1st (King's) Dragoon Guards.

Colonel.

Brotherton, Sir T. W. General, K.C.B,

Captains.

Mitchell, Thos. J.
Wadman, Art. J. P.

2nd (The Queen's) Dragoon Guards.

Lieutenant-Colonels.

Seymour, W. H. C.B.
Walker, C. P. B.

Captain.

Steward, H. H.

Cornet.

Torrens, Robt. H.

3rd (The Prince of Wales) Dragoon Guards.

Lieutenant-Colonel.

Barron, Fenwick B.

Major.

Marsh, Sir Henry, Bart.

Captain.

Francis, Thomas J.

4th (Royal Irish) Dragoon Guards.

Lieutenant-Colonel.

Bentinck, A. Cavendish c.

Captains.

Forster, Francis R. m.
Gunter, Robert.
Fisher, Edward Rowe.

5th (Princess Charlotte of Wales) Dragoon Guards.

Colonel.

Scarlett, Hon. Sir J. Yorke, Major-General, K.C.B.

Major.

Calthorpe, Hon. Somerset J. G.

Captains.

Swinfen, Frederick H.
Godman, R. Temple.

6th Dragoon Guards (Carabineers).

Captain.

Hunter, Robert Scott.

7th (The Princess Royal) Dragoon Guards.

Lieutenant-Colonel.

Thompson, Chas. W.

Captains.

Lamb, W. W.
Dowdeswell, W. F.
Blinkhorn, H.

Lieutenant.

Molyneux, Edm.

1st (Royal) Dragoons.

Colonel.

Clifton, Sir Arthur B. General, K.C.B. K.C.H.

Lieutenant-Colonel.

Wardlaw, R. c.

Major.

Ainslie, James.

Captain.

Nicholl, Hume.

2nd (Royal North British) Dragoons.

Colonel.

Kennedy, A. K. Clark, C.B. Lieut.-Gen.

Lieutenant-Colonel.

Griffith, H. Darby, C.B. c.

Major.

Clarke, G. Calvert c.

Captain.

Buchanan, Geo.

Cornet.

Hozier, John W.

3rd (King's Own) Light Dragoons.

Captain.

Bell, W. M.

4th (The Queen's Own Light) Dragoons.

Colonel.

Scovell, Sir George, General, G.C.B.

Captains.

Browne, C. A. G.
Moore, A. G. M.

Lieutenant.

Calderon, C. M.

Paymaster.

George, Thorne George m.

5th (Royal Irish Light) Dragoons (Lancers).

Colonel.

Chatterton, Sir James Charles, Lieut.-General, Bart. K.H.

Lieutenant-Colonel.

Sulivan, G. A. F. c.

Major.

Portal, Robert.

6th (Inniskilling) Dragoons.

Colonel.

Martin, Thomas, Major-General, K.H.

Captain.

Anderson, T. E.

7th (The Queen's Own Light) Dragoons (Hussars).

Colonel.

Tuyll, Sir William, General, K.C.H.

Lieutenant-Colonel.

Russell, Sir W. Bart. C.B.

Major.

Trevelyan, Harington A.

Captain.

Aytoun, Jas.

Lieutenants.

Herbert, Hon. A. W. E. M.

8th (The King's Royal Irish Light) Dragoons (Hussars).

Colonel.

Lucan, G. C. Earl of, Lieut.-General, K.C.B.

Lieutenant-Colonel.

De Salis, Rodolph c.

Major.

Heneage, Clement W.

Captains.

Clowes, G. G. m.
Mussenden, Wm.

9th (Queen's Royal Light) Dragoons (Lancers).

Colonel.

Sleigh, Sir J. Wallace, General, K.C.B.

Major.

Steele, Aug. F. l. c.

10th (The Prince of Wales's Own Regiment of Light) Dragoons (Hussars).

Colonel.

Beauchamp, Henry B. Earl, General

Lieutenant-Colonel.

Baker, Valentine

Captain.

Bowyer, H. A.

Lieutenant.

Kerr, Lord Ralph D.

11th (Prince Albert's Own) Hussars.

Colonel.

Cardigan, Jas. T. Earl of, Major-General, K.C.B.

Captains.

Harnett, Edw.
Bingham, A. B.
Garnett, A. P.
Tempest, A. C.
Somers, R. John.

Lieutenants.

Robinson, G. C.
Mosley, Paget P.

Veterinary Surgeon.

Anthony, Paul.

12th (Prince of Wales's Royal) Lancers.

Colonel.

Lovell, Sir L. B. Lieutenant-General, K.C.B. K.H.

Lieutenant-Colonel.

Pole, Edward c.

Captain.

Cuninghame, Jno.

13th (Light) Dragoons.

Colonel.

Maclean, A. T. Major-General.

Lieutenant-Colonel.

Tremayne, Arthur.

Captain.

Maclean, Fitzroy D.

14th (The King's Light) Dragoons.

Colonel.

Beckwith, W. Major-General, K.H.

Captain.

Blyth, W. D'Urban.

Lieutenants.

Whish, Claudius B.
Boycott, E. E. Digby.

15th (The King's Light) Dragoons (Hussars).

Colonel.

Bouverie, Everard W. Lieut.-General.

Lieutenant-Colonel.

Fitzwygram, F. W. J.

16th (Queen's) Lancers.

Colonel.

Cust, Hon. Sir Edward, Lieut.-General, K.C.H.

Captains.

Halton, Lancelot
Pigott, Fra. P.

Lieutenant.

Webster, Guy

Cornet.

Gilbard, Geo. J.

Paymaster.

Rosser, Geo. F. m.

17th (Light) Dragoons (Lancers).

Colonel.

Wallace, Sir Jas. Maxwell, Lieutenant-General, K.H.

Cornet.

Bruce, Geo. J. Brudenell. Sub-Lieut.

18th (Light) Dragoons (Hussars).

Colonel.

Byam, Edward, Lieutenant-General.

Lieutenant-Colonel.

Knox, Richard.

Captain.

Palliser, Wm.

Lieutenant.

Filgate, T. P. H. M.

Royal Artillery.

Colonels Commandants.

Tobin, Jos. Webbe. Gen.
Forbes, Thos. Jno. Gen.
Ross, Sir Hew D. G.C.B. Gen.
Turner, George, C.B. Lieut.-Gen.
Gardiner, Sir Robt. Wm. G.C.B. K.C.H. Gen.
Wallace, Peter M. Lieut.-Gen.
Jones, Richard, Lieut.-Gen.
Whinyates, Sir Edwd. Chas. K.C.B. K.H. Lieut.-Gen.
Michell, John, C.B. Lieut.-Gen.
Power, W. Greenshields, C.B. K.H. Gen.
Cobbe, George. Lieut.-Gen.
Mercer, Alex. C. Lieut.-Gen.
Colebrooke, Sir W. M. G. C.B. K.H. Lieut.-Gen.
Cator, Wm. C.B. Lieut.-Gen.
Scott, Hen. Alex. Major-Gen.

Colonels.

Pester, Henry.
Palliser, H.
Cuppage, Burke.
Burn, Robert.
Thorndike, Daniel.
Wilford, Edmd. Neal.
Wingfield, Chas. Wm.
Tulloh, Alex.
Teesdale, Hen. Geo.
Lake, Noel Thos. C.B.
Hill, John.
Morris, Hen. Jos.
St. George, J. C.B.
Nedham, Wm. Robt.
Warde, E. C. C.B.
Ormsby, John Wm.
Taylor, Arthur Jos.
Maclean, George.
Askwith, W. H.
Dunlop, Franklin, C.B.
Dick, Francis.
Dalton, Charles J.
Eardley-Wilmot, F. M.
Fitzmayor, Jas. W. C.B.
Kennedy, G. R. H.
Cockburn, Chas.

Lieutenant-Colonels.

Gambier, Gloucester, C.B. c.
Crofton, E. Walter. c.
Aylmer, Henry. c.

Irving, Alex. C.B. c.
Browne, St. John T. c.
Freese, J. N. A. C.B. c.
Cleaveland, T. Darby. c.
Elwyn, Thomas. c.
Wright, Chas. James. c.
Maclean, Peter. c.
Crawford, Wm. T. C.B. c.
Henderson, Wm. c.
Smythe, W. James. c.
Barker, Sir G. R. K.C.B. c.
Gardner, Wm. Bethel. c.
Lefroy, John Henry. c.
Riddell, C. J. B. C.B. c.
Burrows, Arthur Geo. c.
Price, Edwd. C.B. c.
Domville, Jas. Wm. c.
Wodehouse, Edwin, C.B. c.
Maude, G. A. C.B.
Maberly, Evan, C.B.
Dixon, W. Manley Hall.
Graydon, George.
Dennis, Jas. Benjamin.
Graham, Allan H.
Younghusband, C. W.
Clerk, Henry.
Ward, Fra. B.
Mountain, Rob. F.
Inglefield, S. H. S.

Captains.

Strange, H. Fra. C.B. l. c.
Lawson, Barclay. m.
Williams, E. A. m.
Desborough, John. m.
Hamley, E. Bruce. l. c.
Strange, C. J. m.
Gleig, Alex. C.
Vesey, George Henry.
Vernon, Henry Arthur.
Milman, G. H. L. m.
Baddeley, J. F. L. m.
Smyth, Hen. A.
Phillipps, P. Winsloe.
Blosse, W. C. Lynch.
Gordon, Sam. E. l. c.
Bayly, Neville S. K.
Barstow, George. m.
Thring, John E. m.
Bent, Hugh.
Jervis, Hen. Jervis W.
Reilly, Wm. E. M. C.B. m.
Fitz-Hugh, H. T. m.
Calvert, Archd. m.
Woolsey, O'Brien B.
Drayson, Alfred Wilks.
Elgee, C. Wm.
Forbes, G. H. A.
Michell, John E. l. c.
Henry, Geo. Cecil.
Warlow, Thos. Picton.
Mainwaring, Chas. E.
Grimston, Walter John.
Addington, Hon. Leond. A.
Campbell, Patrick J.
Curtis, Reginald. m.
Bruce, Edwd. Jackson.
Hope, John Edward. m.

2nd Captains.

Miller, Fred. m.
Owen, Chas. Henry. m.
Brabazon, Luke B.
Dames, T. Longworth.
Andrews, Wm. G. m.
Noble, Andrew.
Balfour, Hen. Lowther.
Oldfield, Richard.
Strangways, W. A. F.
Yonge, W. Lambert.
Brackenbury, C. Booth.
Lyon, Francis.
Hutchinson, A. H.
Daubuz, John T.
Downes, Major F.
De Winton, Fra. Walter.
Griffiths, Leonard.

Lieutenants.

Gilmour, C. D.
Ellis, W. Burrowes E.
Franklen, Chas. Richd.
Bazalgette, Sidney Aug.
King, John Robert.
M'Laughlin, Edwd.
Staveley, Edmund.
Parsons, Lawr. H. H.
Cavendish, Jas. Chas.
Rochfort, J. de Burgh.
Forster, Bowes L.
Doull, Alex.
Stoney, Fra. Sadlier.
Tollner, Wm. Michael.
Strahan, Wm.
Sandys, Edwin Wm.
Le Grice, Fred. Swaine.
Hozier, H. M.
Ellis, C. H. Fairfax.
Lloyd, Fra. Thos.
Sladen, Joseph.
Wickham, Edm. Hill.

Chief Paymaster.

Marvin, William. m.

Paymasters.

Patterson, David A. capt.
De la Chaumette, Hen. L. capt.
Piers, C. B. capt.

Surgeons and Assisting Surgeons.

Burn, Rob. D. M.D.

Royal Engineers.

Colonels Commandants.

Whitmore, Sir Geo. K.C.H. Gen.
Pasley, Sir Chas. W. K.C.B. Gen.
Burgoyne, Sir John F. Bart. K.C.B. Gen.
Ellicombe, C. G. C.B. Lieut.-Gen.
Oldfield, John, K.H. Lieut.-Gen.
Smith, Sir J. M. F. K.H. Lieut.-Gen.
Jones, Sir H. D. K.C.B. Lieut.-Gen.
Ward, W. Cuthbert. Lieut.-Gen.

Colonels.

Marlow, W. Biddlecomb.
Stehelin, B. Spicer.
Crawley, Henry Owen.
Walpole, John.
Frome, Edward.
Wilkinson, Chas. Edmd.
Broughton, Wm. E. D.
Burgmann, George.
Denison, Sir W. T. K.C.B.

Lieutenant-Colonels.

James, Sir Henry. c.
Robinson, William. c.
Mould, T. Rawlings. c.
Harness, H. Drury, C.B. c.
Ford, E. Twiss. c.
Yolland, William. c.
Ford, C. Erskine. c.
Moody, R. Clement. c.
Yorke, Fred. A. c.
Skyring, Charles F. c.
Hamilton, R. Gorges. c.
Gordon, John W. C.B. c.
Bainbrigge, Philip Jno.
Cameron, John.
Hawkins, John S.
Fanshawe, Charles.
Chapman, F. E. C.B. c.
Westmacott, Spencer.
Ord, H. St. George.
Simmons, J. L. A. C.B. c.
Baillie, Geo. Clement.
Collinson, T. Bernard.

Captains.

Bayly, John. m.
Owen, H. C. Cunliffe, C.B. l. c.
Jervois, Wm. F. D. m.
Keane, Hon. H. F. m.
Gibbs, Charles Jno. m.
Gosset, W. Driscoll.
Galton, Douglas.
Scott, Henry Y. D.
Ross, George.
Lovell, J. Williamson, C.B. m.
Synge, Millington H.
Ward, E. Wolstenholme.
Grant, J. M.
Fowke, Francis.
Binney, Chas. Rd.
Cooke, A. Charles. m.
Inglis, Thomas.
Hutchinson, C. Scrope.
Wray, Henry.
Pasley, Charles.
Tyler, H. Whatley.
De Butts, John, C.B.
Stace, Walter S.
Stanton, Edw. C.B. l. c.
Chesney, C. Cornwallis.
Ewart, C. Brisbane. m.
Nugent, C. B. P. N. H. m.
Kerr, Robt. D.
Belfield, Edwd.
Wrottesley, Hon. Geo.
Porter, Whitworth. m.
Wilson, John Joshua.
Nicholson, Lothian, C.B. l. c.
Cox, Fra. Edwd.
Farrell, Sidney B.
Stotherd, R. Hugh.
Schaw, Henry.

2nd Captains.

Gordon, Geo. Hamilton.
De Vere, Fras. H. m.
Cumberland, Chas. E. m.
Creyke, Alex. S.
Lempriere, G. Reid.
Lennox, W. Oates. l. c.
Leahy, Arthur. m.
Ducane, Edmd. Fred.
Crossman, Wm.
Marsh, Willoughby D.
Cowell, J. Clayton. m.
Harvey, C. Elwin.
Philips, George,
Drake, John M. C.
James, E. Renouard.
Edwards, James B. m.
Carey, Cons. Phipps.

Lieutenants.

Trench, Hon. W. Le Poer.
Molesworth, Morgan C.
Smith, P. G. L.
Lockhart, Allen E.
Decie, Richard.
Tyler, Edwd. S.
Brooke, Edwd. Thos.
Storer, Arthur T.
Walker, Daniel C.
Home, Rob.
Locock, Herbert.
Jones, R. Owen.
May, Allen.
Parnell, Arthur.
Hamilton, Alex. C.
Crawford, Charles.
Davidson, Chas. R. T.
Salmond, William.

Warren, Charles.
Sitwell, Honorius S.
Carroll, Wm. Joseph.
Grover, Geo. Edward.
Smith, John H.

Military Train.

Colonel Commandant.

Kennedy, J. Clarke, C.B.

Captain.

Fletcher, Thomas.

Grenadier Guards.

Colonel.

Field-Marshal His Royal Highness The Prince Consort, K.G. K.T. K.P. G.C.B. G.C.M.G.

Lieutenant-Colonel.

Lindsay, Hon. Jas. M.P. c.

Majors.

Lambert, John A. c.
Percy, Hon. H. Hugh M. c.
Wynyard, Edw. G.

Captains and Lieutenant-Colonels.

Curzon, Hon. R. W. Penn, C.B. c.
Bruce, Michael.
Conway, T. S. C.B. c.
Maitland, C. Lennox B. c.
Hay, Lord Arthur.
Montresor, Henry E.
Saxe-Weimar, H. S. Highness Prince of. c.
Stuart, Jas. F. D. C.
FitzRoy, Lord Fred. J.
Ponsonby, H. F. c.
Ellison, Cuth. G.
Cust, John Francis.
Cure, Alfred C.
King, John Hynde.
De Horsey, W. H. B.
Higginson, Geo. W. A.
Fox, Aug. H. Lane.
Randolph, Chas. W.
Cooper, Edwd. H.
Burnaby, Edwin S.
Russell, Sir C. Bart.
Hume, Henry, C.B. c.
Hogge, C. Neville.
Burrard, Sidney.
Keppel, Fred. Chas.
Barnard, W. A. M.
Alexander, Claud.
Murray, John.
Burgoyne, Sir J. Montagu, Bart.
Sturt, C. Napier.

Lieutenants and Captains

Ponsonby, A. E. V.
Verschoyle, H. W.
Bathurst, Fred. T. A. H.
Anstruther, Robert.
Hamilton, R. Wm.
Clayton, FitzRoy, A. T.
Bramston, Thos. H.
Pearson, R. L. O. m.
Ewart, W. S.
Stapleton, Fra. Geo.
Ferguson, Geo. A.
Carrick, The Earl of.
Malet, Hen. C. E.
Stanley, Hon. J. C.
Wynne, Edwd. W. L.
Earle, Wm.
Gascoigne, Clifton.
Hood, F. W. Viscount.
Stuckley, W. L.
Clive, Edwd. H.
Davies, Henry F.
Murray, Patrick K.
Tracy, Hon. J. C. G. H.
Parnell, W. H.
Lowe, R. N. C. D. m.
Thynne, Alfred W.
Smith, Philip.
Buller, Reg. J.
Pennant, Arch. C. H. D.
Phillips, Lewis Guy.
Johnstone, John Julius.
Annesley, Hon. Art.
West, Hon. W. E. Sackville.
Gould, Henry O.
Bridges, Edwd. Smith.
Edgcombe, Hon. C. E.
Melville, Norman L.
Hayter, Art. D.

Ensigns and Lieutenants.

Jarrett, Chas. B.
Byng, Alfred M.
Farmer, W. R. G.
Fairfax, Thos. F.
Nugent, Edm. C.
Norton, Rob. T. L.
Cholmeley, Hugh H.
Fludyer, Chas.
Hinchinbrook, Viscount.
Stanley, Hon. Fred. A.
Mahon, Viscount.
Uffington, W. A. F. Viscount.
Hope, Henry W.
Eliot, Hon. C. G. C.
Seymour, Leopold R.
Clinton, Henry R.

Quartermaster.

Atkinson, John.

Battalion-Surgeon.

Nicoll, Charles R. Surgeon-Major.

Assisting Surgeons.

Lawrence, Henry J. H.
Read, C. C.

Coldstream Guards.

Colonel.

Clyde, Colin Lord, General, G.C.B.

Majors.

Newton, Wm. S. c.
Perceval, Spencer. c.

Captains and Lieutenant-Colonels.

Steele, Thos. M. C.B. c.
Wood, Wm. Mark. c.
Carleton, Dudley W.
Stepney, A. St. George H. C.B. c.
Airey, J. T. C.B. c.
Dawkins, W. Gregory.
Strong, Clem. W.
Hardinge, Hon. A. E. C.B. c.
Feilding, Hon. P. R. B.
Reeve, Wm. Hen.
Baring, Charles.
Byng, Hon. H. W. J.
Le Couteur, J. H.
Armytage, Henry.
Goodlake, G. L.
Tower, Harvey.
Dangan, W. H. Viscount.
Freemantle, Art. Jas.

Lieutenants and Captains.

Cecil, Lord E. H. B. G.
Blackett, Chas. Edward.
Boyle, Hon. W. G. m.
Conolly, John Aug. m.
Holmesdale, Viscount W. Archer.
Greenhill, Charles.
Jervoise, Henry C.
Campbell, Hon. H. W.
Hall, Julian H.
Wigram, Godfrey J.
Lambton, Arthur.
Edwardes, Hon. W.
Lane, H. J. Bagot.
Seymour, W. F. E.
Legge, Hon. Edw. Hen.
Burnell, E. S. Pegge.
Windsor-Clive, Hon. C. H. W.
Thursby, R. Hasel.
Burnand, Norman.
Wynne, Wm.
Freemantle, Fitzroy W.
Reeve, Ellis P. F.

Ensigns and Lieutenants.

Buller, Fred. C.
Bonham-Carter, H.
Fortescue, Hugh G.
Herbert, Henry Art.
Baring, Denzil H.
Lee-Mainwaring, C. W.
Hamilton, Sir E. A. Bart.

Surgeon-Major.

Monro, James, M.D.

Assisting Surgeon.

Wyatt, John.

Scots Fusilier Guards.

Colonel.

Cambridge, His Royal Highness the Duke of, General, K.G. K.P. G.C.B. G.C.M.G.

Lieutenant-Colonel.

Ridley, Wm. John. c.

Majors.

Seymour, Fred. C.B. c.
Dalrymple, J. H. Elphinstone. c.

Captains and Lieutenant-Colonels.

De Bathe, Henry P. c.
Stephenson, F. C. A. C.B. c.
Hepburn, Henry P.
Charteris, Hon. R.
Wilkinson, Henry G.
Scarlett, Hon. W. F.
Meyrick, A. W. H.
Aitchinson, Wm.
Neville, Edwd.
Gipps, Reginald.
Coke, Hon. W. C. Walpole.
Baring, Francis.
Fletcher, Henry C.
Farquharson, Jas. Ross.
White, Raymond H.
Lambton, Francis.
Mostyn, Hon. Roger.
Campbell, Arch. C.
Tottenham, Charles G.

Lieutenants and Captains.

Gordon, G. Grant.
Hay, Hon. C. Rowley.
Moncrieff, G. Hay.
Peel, Cecil L.
Jelf-Sharp, Henry.
Paynter, John.
Knox, Geo. W.
Trefusis, Hon. Walter R.
Beaumont, Godfrey W.
Cooper, Rich. A.
Erskine, Henry D.

Rooke, Willoughby S.
Shelley, Charles.
Elphinstone, John F. B.
Palmer, Frederick.
Massey, Hon. L. E.
Pemberton, Chris. Peach.
Bowden, Hen. Geo.
Ford, James Edw.
Stephenson, Sussex V.
White, Charles Wm
Elwes, Windsor C. C.
Stracey, Henry H. D.

Ensigns and Lieutenants.

Dalzell, Rob. A.
Cunliffe, Sir Rob. A. Bart.
Smith, Gerald.
Speirs, Archd. Alex.
Tullibardine, Marquis of.

Surgeon-Major.

Bostock, J. Ashton, M.D.

Assisting Surgeons.

Elkington, Arth. G.
Baker, Francis B.
Turner, Henry.

1st (The Royals) Regiment.

Colonel.

Blakeney, General, Right Hon. Sir Edw. G.C.B. G.C.H.

Ensign.

Atkinson, Thos. 1st

2nd (Queen's Royals).

Colonel.

Spink, John, Lieut.-Gen. K.H.

Lieutenant-Colonel.

Bruce, Robert. 2nd

Majors.

Addison, Thomas. l. c. 1st
Gibbs, Charles.

Lieutenants.

Turnor, George, 2nd

Ensign.

Twyford, A. F.

Paymaster.

Simpson, R. H.

3rd (The Buffs).

Colonel.

Grey, Hon. Charles, Major-General.

Major.

King, H. J. 1st

Captains.

Pearson, C. K. 2nd
Cowell, H. R. 2nd

4th (King's Own).

Colonel.

Bell, Sir John, General, G.C.B.

Majors.

Cameron, W. G. 1st
Cocks, O. Y. 2nd

Captain.

Congreve, Wm. 2nd

Lieutenant.

Chinn, E. 2nd

5th (Northumberland) Fusiliers.

Colonel.

Walton, Wm. Lovelace, Lieutenant-General.

Lieutenant-Colonels.

Guy, P. M. N. C.B. c. 1st
Kirkland, J. A. V. 2nd

Major.

Bartley, J. C. 2nd

Captains.

Pender, Fra. H. 1st
Adair, J. W. Dunlop 2nd
Ross, A. E. 2nd
Walpole, Horatio 1st

6th (Royal First Warwickshire).

Colonel.

Riddell, K. H.
James, Henry, General.

Lieutenant-Colonel.

Robertson, J. E. 1st

Captains.

Black, Wilsone 2nd
Lawrell, Hen. John 1st

Ensign.

Blair, J. B. 2nd

7th (Royal Fusiliers).

Colonel.

Auchmuty, Sir Samuel Benjn. General, K.C.B.

Major.

Watson, Charles E. 1st

Captains.

Waller, Geo. Henry 1st
Daubeny, A. G. 2nd

Lieutenant.

Frampton, Wm. John 1st

8th (The King's Regiment).

Colonel.

Monins, Eaton, Major-General.

Lieutenant-Colonels.

Wilson, T. M. c. 2nd
Haines, F. P. c. 1st

Major.

Robertson, Alex. C. l. c. 1st

Captains.

Beere, D. 2nd
Dyer, H. S. 2nd
Bruce, R. C. D. 2nd
Dugmore, W. F. J. 1st
Tanner, Edward 2nd

Lieutenants.

Brown, C. B. 2nd
Moore, F. G. Furlong 2nd
Wheeley, J. S. 2nd
Aylmer, J. E. F. 2nd
Madden, W. W. 1st

Ensigns.

Skinner, Theodore H. 2nd

9th (The East Norfolk).

Captains.

Darling, S. m. 1st
Scott, H. Bassett. m. 1st
Gammell, John H. H. 1st

10th (North Lincoln).

Lieutenant-Colonel.

Longden, H. E. C.B. c. 1st

Lieutenant.

Berger, Ernest A. 2nd

11th (North Devon).

Colonel.

Doherty, Sir Richard, Lieut.-General.

Captain.

Philpot, Philip 1st

Lieutenant.

Hare, Edward Henry. 2nd

12th (East Suffolk).

Colonel.

Bentinck, C. A. F. Lieut.-General.

Major.

Kempt, J. Francis 1st

Captains.

Espinasse, J. W. 2nd
Dundas, Thos. 2nd
Wilkie, John L. 1st
Fitzgerald, F. A. 1st

Lieutenants.

Lacy, G. de L. 2nd
Johnson, J. O. 2nd
Dunlevie, Wm. S. Henry 2nd
MacDonnell, H. J. 2nd

13th (Prince Albert's) Light Infantry.

Colonel.

Gomm, Sir Wm. Maynard, General, G.C.B.

Lieutenant-Colonels.

Kerr, Lord Mark, C.B. c. 1st
King, George 1st

Captains.

Long, C. P. 1st
Cobbe, C. P. 2nd

Lieutenant.

Gould, T. T. 2nd

Surgeon.

Ligertwood, T. M.B. 1st

14th (Buckinghamshire).

Colonel.

Watson, Sir James, General, K.C.B.

Lieutenant-Colonels.

Budd, Ralph 1st
Alexander, Sir J. E. c. 2nd

Majors.

Trevor, Wm. C. 1st
Holworthy, Edw. J. 1st

Captains.

Hammersley, F. m. 1st
Grogan, Chas. Edw. 1st
Maycock, John G. 1st
Petrie, Martin 1st
Cosby, Thos. P. 1st
Heywood, Wm. 2nd
Le Mesurier, And. A. 1st
Mackenzie, J. D. 2nd
Gleig, C. E. S. m. 1st

Lieutenants.

Costin, Charles 1st
Burton, Henry A. 1st
Laing, Joseph 1st

Ensigns.

Williams, Henry A. 1st
Hutchison, Henry M'L. 1st

Paymaster.

Macdonnell, Wm. 1st

Surgeons.

King, G. S. M.D. 1st

15th (York, East Riding).

Colonel.

Douglas, Sir Howard, Bart. General, G.C.B. G.C.M.G.

Lieutenant-Colonel.

Cole, John A. 1st

Captains.

Twynam, P. A. A. 1st
Oldfield, Aldred 2nd
Nangle, Henry 1st

Lieutenant.

Layard, Chas. E. 2nd

16th (Bedfordshire).

Colonel.

Berkeley, Sackville H. General.

Lieutenant-Colonel.

Peacocke, Geo. John. 1st

Major.

De Winton, C. L. 2nd

Captains.

Armstrong, Chas. 1st
Lombard, G. C. S. 2nd

Lieutenant.

Kelsall, Henry 2nd

17th (Leicestershire).

Colonel.

Airey, Sir Richard, Major-General, K.C.B.

Major.

Colthrust, D. Latouche. 2nd

Lieutenant.

Perceval, John J. 2nd

18th (Royal Irish).

Lieutenant-Colonel.

Grant, John Thornton. C.B. c. 1st

Major.

Carey, G. J. c. 2nd

Captains.

Pocklington, Geo. H. 1st
Havelock, Sir Henry M. Bart. l. c. 2nd
Baker, Thos. D. 2nd
Vickars, H. G. A. 2nd

19th (1st York, North Riding).

Colonel.

Rowan, Sir W. Lieut.-Gen. K.C.B.

Lieutenant-Colonels.

Mundy, Geo. V. C.B. c. 1st
Bright, Robt. O. 1st
Warden, Robert. 2nd

Major.

Graham, Lumley. l. c. 2nd

Lieutenant.

Browne, H. John. 1st

20th (East Devonshire).

Captains.

O'Brien, J. T. N. m. 1st
Jones, E. Monckton. 2nd

21st (Royal North British Fusiliers).

Colonel.

Evans, Sir De Lacy, Lieut.-Gen. G.C.B.

Major.

Steward, E. A. T. 2nd

Captains.

Peddie, Crofton. 1st
Templeman, Alfred. 2nd
Sheffield, John Charles. 1st
Carleton, Wm. Henry. 2nd
Cairnes, W. 1st
Hollway, T. Burchell. 1st
Holt, Alfred. 1st

Lieutenant.

Winslow, Richd. W. C. 1st

Quartermaster.

Grahame, Geo. 1st

22nd (The Cheshire).

Colonel.

Pennefather, Sir J. L. Lieut.-Gen. K.C.B.

Lieutenant-Colonel.

Harding, F. Pym, C.B. c. 1st
Anderson, David. 2nd

Majors.

Robinson, Sir G. A. Bart. 1st
Bowden, Herbert Geo. 2nd

Captains.

Young, Thomas. 1st
Molony, W. M. 2nd
M'Bean, William 1st
Thursby, James L. 1st
Swann, John S. 2nd

23rd (Royal Welsh Fusiliers).

Colonel.

Codrington, Sir Wm. J. Lieut.-Gen. K.C.B.

Lieutenant-Colonel.

Pratt, Robert, C.B. 1st

Majors.

Bulwer, E. G. C.B. l. c. 2nd
Gubbins, James. 2nd
Torrens, Henry D. l. c. 1st

Captains.

Granville, Bevill. m. 2nd
Reid, David 2nd
Blane, Charles G. 2nd
Armstrong, Edw. 2nd

Lieutenants.

Bussell, G. W. H. 2nd
Hutton, Fred. Wm. 2nd
Walwyn, Jas. H. 2nd
Lewis, Geo. Wm. 2nd
Molyneux, A. M. 1st

Assistant-Surgeon.

Berkeley, R. W. 2nd

24th (2nd Warwickshire).

Colonel.

Finch, Hon. J. Lieut.-Gen. C.B.

Captains.

Clark, Thomas. 2nd
Godwin-Austen, H. H. 1st

Lieutenant.

Plasket, W. A. H. 2nd

25th (The King's Own Borderers).

Paymaster.

Brumell, Wm. m.

26th (Cameronians).

Colonel.

Bainbrigge, Sir Philip, Lieut. Gen. K.C.B.

Captain.

Lockhart, Wm. E.

Ensign.

Buchanan, Jas. R. G.

27th (Inniskilling).

Colonel.

Geddes, John, Major-General, K.H.

28th (North Gloucestershire).

Colonel.

Bentinck, Sir. Hen. J. W. Lieut.-Gen. K.C.B.

29th (Worcestershire).

Colonel.

Downes, Ulysses, Lord, General, G.C.B.

30th (Cambridgeshire).

Colonel.

Tweeddale, George, Marquis of, General, K.T. C.B.

Captain.

Deedes, Wm.

Paymaster.

Lamert, G. F.

31st (Huntingdonshire).

Colonel.

Craigie, P. E. Lieut.-Gen. C.B.

Lieutenant-Colonel.

Sutton, Wm. c.

Major.

Swaffield, C. J. O.

Captain.

Mitchell, Alex.

Lieutenant.

Pepper, Geo. N.

32nd (Cornwall Light Infantry).

Colonel.

Inglis, Sir John E. W. Maj.-Gen. K.C.B.

Lieutenant-Colonel.

Stapylton, G. G. C.

Captain.

Colls, Robt. Stacy. m.

33rd (The Duke of Wellington's Regiment).

Colonel.

York, Sir Charles, Lieut.-Gen. G.C.B.

Lieutenant-Colonel.

Collings, John E.

Major.

FitzGerald, Henry C.

Captain.

Vacher, F. S. m.

34th (Cumberland).

Colonel.

Eden, John, Maj.-Gen. C.B.

Major.

Maxwell, James.

Captains.

Marsh, Edward H.
Chapman, Art. T. L.
Boyce, Abel W.
Moore, J. Leslie.
Saunders, T. Harry.

Lieutenants.

Dunbar, Wm. M.
Laurie, Julius D.
Leeson, R. J. P. Adjt.
Leeson, C. E.

Ensign.

Webb, C. H.

35th (Royal Sussex).

Lieutenant.

Lloyd, Thos.

36th (Herefordshire).

Colonel.

Scott, Wm. Henry, Lieut.-Gen.

Lieutenant-Colonel.

Hort, John J.

Captain.

Twyford, Henry R.

Lieutenant.

Powys, Hon. C. J. Fox.

37th (North Hampshire).

Colonel.

Fraser, John, Lieut.-Gen.

Captains.

Heaton, John R. l. c.
Ind, Fred. J. Nash.

Lieutenant.

Bunn, Richard.

38th (1st Staffordshire).

Colonel.

Arbuthnott, Hon. Hugh, General, C.B.

Lieutenant-Colonels.

Sparks, J. P. C.B. c.
Haly, W. O'Grady, C.B. c.

39th (Dorsetshire).

Nil.

40th (2nd Somersetshire).

Colonel.

Woodford, Sir Alexander, General, G.C.B. G.C.M.G.

Lieutenant-Colonel.

Leslie, Arthur.

41st (The Welsh).

Colonel.

A'Court, Repington, C. Ashe, General, C.B. K.H.

Captain.

Bertram, C. P. m.

42nd (Royal Highlanders).

Nil.

43rd (Monmouthshire Light Infantry).

Colonel.

Fergusson, Sir James, General, G.C.B.

Captain.

Glover, Robert Coke.

Lieutenants.

Glover, F. G. E.
M'Goun, Thos.

Ensigns.

Villiers, Ernest.
Hogarth, Joseph.
Salmon, Chas.

Paymaster.

Morgan, Horatio.

44th (East Essex).

Colonel.

Reed, Thos. Lieut.-General, C.B.

Major.

Hackett, John.

45th (Nottinghamshire).

Lieutenant-Colonel.

Cooper, Henry. c.

Captains.

Parish, H. Wood. m.
Wood, J. J.

Lieutenants.

Webber, Fred. W. S.
Hayward, Henry B.

Ensigns.

Hooke, Henry H.
Hancock, Hen. J. B.
De Thoren, Oscar W.

Paymaster.

Blythe, John D.

46th (South Devon).

Nil.

47th (The Lancashire).

Majors.

Lowry, Rob. Wm. l. c.
Lodder, Hen. Call.

48th (Northamptonshire).

Lieutenant-Colonels.

Riky, Benjamin. c.
Campbell, A. Neil.

49th (The Princess Charlotte of Wales's).

Colonel.

Bowater, Sir Edward, General, K.C.H.

Lieutenant-Colonel.

Edwards, Clement A. C.B. c.

Captain.

Gibson, C. E.

Lieutenant.

Eustace, Thos. Fox.

50th (Queen's Own).

Colonel.

England, Sir Richard, Lieut.-General, G.C.B. K.H.

Captain.

Lock, A. C. K. m.

Lieutenant.

Goff, Rob. Chas.

51st (The King's Own) Light Infantry.

Lieutenant-Colonels.

Errington, Arnold C.
Irby, Aug. H.

Captain.

Cleeve, Stewart A.

Ensign.

Robertson, Geo. S.

52nd (Oxfordshire) Light Infantry.

Major.

Peel, Art. Lennox.
Bourchier, Jas. Johnes.

Captains.

Curzon, Hon. Ernest G.
Monson, Hon. D. J.
Blane, Seymour J. m.
Adair, Alex. W.

Lieutenants.

Cowburn, Thos. B.
Adair, Henry A.

53rd (The Shropshire).

Colonel.

Maunsell, Fred. Major-General.

54th (West Norfolk).

Colonel.

Fane, Mildmay, Lieut.-General.

Lieutenant.

Bayly, Vere Temple.

55th (Westmoreland).

Colonel.

Schoedde, Sir James Holmes, Lieut.-General, K.C.B.

Captains.

Wilson, S. W. F.
Bellamy, Percy L.

56th (West Essex).

Colonel.

Breton, H. Wm. Major-General.

Lieutenant.

Thompson, Robt. T.

Ensign.

Heyland, Art. Rowley.

57th (West Middlesex).

Colonel.

Love, Sir Jas. Fred. Lieut.-General, K.C.B. K.H.

Lieutenant-Colonels.

Warre, Henry J. C.B. c.
Inglis, Wm.

Lieutenant.

Clarke, Chas. M.

Ensign.

Manners, Art. C.

58th (Rutlandshire).

Colonel.

Wynyard, Edw. Buckley, General, C.B.

Lieutenant-Colonel.

Bridge, Cyprian.

Captains.

Shipley, Wm. D.
Hall, Angus W.
Horner, John.

Ensign.

Butler, Henry Thomas.

59th (2nd Nottinghamshire).

Colonel.

Taylor, Jer. Lieut.-General.

60th (The King's Royal) Rifle Corps.

Colonel-in-Chief.

Gough, Hugh, Viscount, General, K.P. G.C.B.

Colonel-Commandant.

Moore, Sir W. G. Lieut.-Gen. K.C.B.

Lieutenant-Colonel.

Jones, Sir J. K.C.B. c. 1st

Majors.

North, C. N. l. c. 1st
Feilden, R. Joseph. 4th

Captains.

Battersby, J. P. 3rd
Churchill, C. H. S. m. 3rd
Travers, Fras. S. 4th

Lieutenants.

Morrah, James Art. 2nd
Moseley, W. H. 2nd

61st (South Gloucestershire).

Colonel.

Reeve, John, General.

Major.

Redmond, J. Pat.

Lieutenant.

Yonge, Henry John.

62nd (The Wiltshire).

Colonel.

Knollys, Wm. T. Lieut.-General.

Lieutenant-Colonel.

Ingal, Lenox W. C.B. c.

Major.

Daubeny, James, C.B. l. c.

Captains.

Wilkieson, Geo. H.
Hay, Graham.

Lieutenant.

Grant, George Fox.

63rd (The West Suffolk).

Colonel.

Kenah, Thomas, General, C.B.

Major.

Grey, Fra. D.

Captain.

Paterson, F. T. L.

Lieutenants.

Clutterbuck, Geo. W.
Crowther, R. W. B.
Boyd, James P.

Ensigns.

Smyth, James S.
Atkinson, Thos.
Scovell, Thornton.

64th (2nd Staffordshire).

Colonel.

Freeth, James, Lieut.-General, K.H.

Lieutenant-Colonel.

Bingham, G. W. P. C.B.

Major.

Anderson, Thomas.

65th (2nd Yorkshire, North Riding).

Captain.

Blewitt, Charles.

66th (Berkshire).

Captain.

Walker, John.

67th (South Hampshire).

Colonel.

Davies, Fra. J. Lieut.-General.

Lieutenant-Colonel.

Knox, Thos. Edmd.

Major.

Porter, John.

Captains.

Thompson, Daniel.
Jebb, Fred. Wm.

68th (The Durham) Light Infantry.

Lieutenant-Colonel.

Greer, H. Harpur.

Major.

Morant, H. H.

Captains.

Fitzroy, Cavendish C.
Oakley, G. J. A.

69th (South Lincolnshire).

Colonel.

Gascoigne, Ernest F. Lieut.-General.

Lieutenant-Colonel.

Mackirdy, Dav. E. c.

Captains.

Charleton, T. H.
Leggett, Robt. A.

70th (The Surrey).

Colonel.

Paty, Geo. Wm. Lieut.-General, C.B. K.H.

Lieutenant-Colonel.

Galloway, Thos. James.

Assisting-Surgeon.

Alston, W. E. M.D.

71st (Highland) Light Infantry.

Lieutenant-Colonels.

Hope, William, C.B.
Rich, George W. T.

Major.

Gore, James Art.

Captain.

Mounsey, Chas. J.

Lieutenants.

Lewis, Robert.
Isacke, R. J.
Leslie, John Henry.

72nd (Highlanders).

Colonel.

Aitchison, Sir John, General, K.C.B.

Major.

Norman, C. J. W.

Surgeon.

Seaman, W. C. M.D.

73rd Regiment.

Majors.

Jones, Hugh M.
Bewes, W. E. l. c.

Captains.

O'Brien, W. Creagh.
Reeve, Frederick.
Henslowe, Spencer V. F.

Ensign.

Turner, J. T.

74th (Highlanders).

Colonel.

Shawe, Chas. A. Lieut.-General.

Captain.

Dormer, Hon. J. B. J.

75th Regiment.

Colonel.

Clerke, St. John A. Lieut.-General, K.H.

76th Regiment.

Colonel.

Jervois, William, General, K.H.

Lieutenant-Colonel.

Smyth, Henry, C.B. c.

Major.

Dennis, M. S. T.

77th (East Middlesex).

Lieutenant-Colonels.

Chichester, Hon. A. G. C.
Deverell, Thos. J. c.

78th (Highlanders).

Lieutenants.

Barker, George D.
Ingles, Hen. A.

79th (Cameron Highlanders).

Lieutenant-Colonel.

Butt, Thos. B.

Captains.

Scovell, G. T.
Harrison, G. A.

80th (Staffordshire Volunteers).

Colonel.

Robbins, T. W. Lieut.-General.

81st (Loyal Lincoln Volunteers).

Colonel.

Evans, Thomas, General, C.B.

Lieutenant-Colonel.

Renny, Henry. c.

82nd (The Prince of Wales's Volunteers).

Colonel.

Ashburnham, Hon. Thos. Lieut.-Gen. C.B.

Captain.

Marriott, Henry C. m.

Lieutenant.

East, Cecil J.

Ensign.

Marchant, C. H.

83rd (County of Dublin).

Colonel.

Stovin, Sir Fred. General, G.C.B. K.C.M.G.

Lieutenant.

Brymer, James E.

84th (York and Lancaster).

Colonel.

Wetherall, Sir Geo. A. Lt.-Gen. K.C.B. K.H.

85th (The King's Light Infantry).

Colonel.

Guise, Sir John W. Bart. General, K.C.B.

Captain.

Baker, Wm. Thos.

Lieutenant.

Mathew, W. H.

86th (Royal County Down).

Nil.

87th (Royal Irish Fusiliers).

Colonel.

Simpson, Sir James, General, G.C.B.

Major.

Hamilton, L. H.

88th (Connaught Rangers).

Captain.

Crosse, Jos. Grant. m.

89th Regiment.

Nil.

90th (Light Infantry).

Colonel.

Macintosh, A. Fisher, Lieut.-General, K.H.

Captain.

Gale, Hen. R. H.

Lieutenant.

Haig, J. F

91st (Argyllshire).

Colonel.

Gore, Hon. Sir Charles, Lieutenant-General, K.C.B. K.H.

Lieutenant-Colonel.

Patterson, W. T. L.

Captains.

Sweny, J. C.
Dewell, Chas. G.
D'Eye, W. Rust.

Lieutenants.

Spearman, Horace R.
Harvey, Chas. L.

92nd (Highlanders).

Lieutenant-Colonel.

Lockhart, A. Inglis, C.B. c.

Major.

Mackenzie, K. D. l. c.

93rd (Highlanders).

Colonel.

Sutherland, Wm. Lieut.-General, C.B.

Captains.

Burroughs, F. W. m.
Knollys, W. W.

Lieutenant.

Tabateau, A. O.

94th Regiment.

Colonel.

Higginson, G. P. Lieut.-General.

Lieutenant-Colonel.

Mills, C. J. c.

Captains.

Cafe, Haydon L.
Peacocke, T. G.
Elliot, A. C.
Elliot, F. H.

Lieutenants.

Malthus, Sydney, Adjutant.
Teevan, G. J.
Steuart, Ramsay.
Anstruther, F. R.
Pilkington, J. B.
Mackinlay, J.

Ensign.

Buller, W. G.

Paymaster.

Wahab, H. J.

Assistant-Surgeon.

Leask, J. G. M.B.

95th (The Derbyshire).

Colonel.

Cockburn, Sir Francis, General.

Lieutenant-Colonels.

Raines, Julius A. R. C.B. c.
Thesiger, Hon. F. A.

Captains.

Carmichael, Geo. L. m.
Maurice, R. M. B.

Lieutenant.

Chapple, E.

Surgeon.

Gibbons, John.

96th Regiment.

Lieutenant-Colonel.

Scovell, Edw. W.

Captain.

Kirk, James B.

97th (Earl of Ulster's).

Colonel.

Morris, Edm. F. Lieut.-General, C.B.

Lieutenant.

FitzGerald, M. G. B.

98th Regiment.

Colonel.

Darling, Wm. Lindsay, Lieut.-General.

Lieutenant-Colonels.

Rainier, Daniel. c.
Bates, Henry. c.

Major.

Peyton, Francis.

Captain.

Crawford, Francis H.

Lieutenant.

Gardiner, Thomas.

99th (Lanarkshire).

Majors.

Dowbiggin, M. H.
Blamire, Charles.

100th (Prince of Wales Royal Canadians) Regiment.

Colonel.

Melville, Henry Viscount, Lieut.-General, K.C.B.

Captains.

Cook, Henry.
Slade, A. F. A.

Ensign.

Ashford, Henry Wm.

Rifle Brigade.

Colonel-Commandant.

Brown, Right Hon. Sir Geo. General, G.C.B. K.H.

Lieutenant-Colonels.

Elrington, F. R.	4th
Hardinge, Henry.	3rd

Majors.

Newdegate, Edwd.	4th
Elliot, Hon. G.	4th
Walker, Hercules.	2nd

Captains.

Bourchier, Claude T. m.	3rd
Blackett, Edwd. W.	4th
Hill, Horace F.	3rd
Maclean, H. J.	1st
Milles, Hon. L. W. m.	2nd
Rose, Geo. E.	3rd
Moore, John Croft.	4th
Clerk, John.	2nd
Coulson, John B. B.	2nd
Harington, R. E. Stuart.	1st
Wood, Henry.	3rd
Seymour, F. H. A.	2nd

Lieutenants.

Stade, Charles Geo. 1st
Blundell, H. B. H. 1st
Green, Andrew. 3rd
Mildmay, H. A. St. J. 4th
Ramsbottom, F. W. 2nd

Ensign.

Turnor, Chris. H. 4th

1st West India Regiment.

Colonel.

Bowles, Sir George, General, K.C.B.

Lieutenant-Colonel.

O'Connor, L. S. C.B. c.

2nd West India Regiment.

Colonel.

Frith, John W. Major-General.

Lieutenant-Colonels.

Whitfeild, Henry W. c.
Gibbings, Thomas.

Major.

Hill, William.

3rd West India Regiment.

Colonel.

Wood, William, General, C.B. K.H.

Ensign.

Hincks, Alex. Stewart.

Quarter-Master.

Doorly, Martin.

Ceylon Rifle Regiment.

Captain.

Meaden, James.

Ensign.

Baldwin, Fred. C.

Cape Mounted Riflemen.

Lieutenant-Colonel.

Staunton, George. c.

Captain.

Pole, Chas. Van Notten.

Lieutenant.

Brabant, Edw. Yewd.

Ensigns.

Hay, T. H. V. D.
Marillier, Chas. H.
Pote, C. St. Clare.

Royal Canadian Rifle Regiment.

Lieutenant-Colonel.

Braford, W. H. c.

Captain.

Grange, Chas. W. m.

Royal Newfoundland Companies.

Major.

Grant, John James.

DEPOTS AND DEPOT BATTALIONS.

Invalid Depot, Chatham.

Staff Captain.

De Teissier, J. F. l. c.

School of Musketry, Hythe.

Commandant and Inspector-General.

Hay, C. C. Major-General.

Cavalry Depot, Maidstone.

Commandant.

Gibsone, J. C. H. c.

Assistant-Commandant.

Teusch-Hecker, C.H. Lieut.-Col.

Cavalry Depot, Canterbury.

Major.

Tomkinson, Edwd.

2nd Depot Battalion, Chatham.

Commandant.

Phillips, R. Newton. c.

Major.

Stewart, W. L. l. c.

5th Depot Battalion, Isle of Wight.

Lieutenant-Colonel.

Jeffreys, E. R. C.B. c.

Major.

Tritton, F. B.

6th Depot Battalion, Walmer.

Paymaster.

Burney, H. S. S. m.

7th Depot Battalion, Winchester.

Lieutenant-Colonel.

M'Donald, A. M.

Major.

Wombwell, Art.

10th Depot Battalion, Colchester.

Instructor of Musketry.

Chapman, Capt. A. T. L.

11th Depot Battalion, Preston.

Major.

Skipwith, Geo.

12th Depot Battalion, Athlone.

Major.

Nason, J.

Paymaster.

Benson, G. T. m.

15th Depot Battalion, Buttevant.

Staff Surgeon.

Clarke, John. M.D.

16th Depot Battalion, Templemore.

Major.

Charter, E. J.

17th Depot Battalion, Limerick.

Lieutenant-Colonel.

Borton, Arthur, C.B. c.

Major.

Yonge, G. N. K. A.

Paymaster.

Fair, Alex.

18th Depot Battalion, Fermoy.

Lieutenant-Colonel.

Egerton, C. R.

19th Depot Battalion, Fermoy.

Major.

Chichester, Chas. R.

21st Depot Battalion, Chichester.

Lieutenant-Colonel.

Wright, E. W. C.

22nd Depot Battalion, Stirling.

Paymaster.

Hall, John Peter.

Convalescent Establishment, Yarmouth.

Commandant.

Jervois, Captain E. S.

Paymaster.

Naylor, S. m.

RECRUITING STAFF.

Bristol.

Sullivan, Col. Wm. C.B. I.F.O.

Superintendent Officer.

Bussell, Lieut. G. W. H. 23rd Fus.

London.

Superintendent Officer.

Fitzgerald, Lieut. M. G. B. 97th Foot.

Glasgow.

Superintendent Officer.

Browne, H. J. Lieut. 19th Foot.

Dublin.

Brooke, E. B. Col. I.F.O.

Cork.

Gardiner, R. Col. I.F.O.

Paymaster.

Fitzgerald, W. H. Major.

Royal Engineers.

Crawley, H. O. Col. Exeter.
Stotherd, R. H. Capt. Edinburgh.

STAFF OFFICERS OF PENSIONERS.

Superintendent.

Tulloch, Sir A. M. Major-Gen.

Assisting Superintendent.

Crofton, John, Col.

Edinburgh.

Hope, F. Col.

Glasgow.

Campbell, Walter, Col.

Hull.

Teale, C. S. Lieut.-Col.

Ipswich.

Capel, S. A. Major.

London.

Campbell, G. H. F. Col.
O'Brien, R. S. Major.
M'Nair, R. Capt.
Graham, J. J. Col.
Christie, F. G. Major.

Plymouth.

Russell, H. Lieut.-Col.

Limerick.

Bayly, Geo. Major.

Sunderland.

Parkinson, C. F. Col.

Commissariat Department.

Deputy Commissary Generals.

Morse, H. B.
Carpenter, F. S.
Power, W. J. T. C.B.

Assisting Commissary Generals.

Strickland, Edward
Salwey, A.
De Fonblanque, E. B.

Deputy Assisting Commissary Generals.

Cookesley, A. F.

Medical Department.

Director General.

Gibson, J. B. M.D. C.B.

Inspector Generals.

Logan, T. G. M.D.
Williams. J. E.

Deputy Inspector Generals.

Lawson, Robert.
M'Ilree, John D.
Longmore, Thos.
O'Flaherty, R. J.
Balfour, T. G. M.D.
Mapleton, H. M.D.
Maclachlan, D. M.D.

Staff Surgeon Majors.

Anderson, Geo.
Webster, G. M. M.D.

Staff Surgeons.

Docker, E. S.
Smith, H. F. M.D.
Clarke, J. M.D.

Purveyors Department.

Purveyor.

Harrington, S. C.

Chaplains' Department.

Chaplain General.

Gleig, Rev. G. R. M.A.

Chaplains to the Forces.

Browne, R. W.
Sykes, W. Cape of Good Hope.

Barrack Master.

Sutherland, E. Major.	Woolwich.
White, L. Major.	London.
Sanders, G. H. Lieut.	Parkhurst.

Royal Marines, Light Infantry.

Colonel Commandant.

Rea, Edwd.

2nd Commandants.

Lemon, Thos. C.B.
Moore, T. C. C.

Lieutenant-Colonels.

Langley, Geo. Colt. c.
Travers, Jos. Oates.
March, W. H.

Captain.

Fellowes, P. H.

Lieutenant.

Shanks, Jos. Geo.

Deputy Adjutant General.

Wesley, S. R. Maj.-Gen.

WAR OFFICE (Pall Mall).

Secretary of State.

Herbert, the Right Hon. Sidney, M.P.

Under Secretary of State.

De Grey and Ripon, Earl.
Lugard, Sir E. Maj.-Gen. K.C.B.

Inspector General of Fortifications.

Burgoyne, Sir John, Gen. G.C.B.

Deputy Inspector General of Fortifications.

Foster, Thos. Maj.-Gen.

Assisting Inspectors General of Fortifications.

Jervois, W. F. D. Major.
Belfield, E. Capt.
Galton, D. Capt.

Inspector General of Militia.

Paulet, Lord F. Col. C.B.

Inspector General of Volunteers.

M'Murdo, W. M. S. Col. C.B.

Engineer for Rifled Ordnance.

Armstrong, Sir W. Geo. C.B.

Director of Stores and Clothing.

Caffin, J. C. Capt. R.N.

Assistant Accountant-General.

Whiffin, H. W. S. Esq.

Topographical Department.

Director.

James, Sir Hen. Col. R.E.

Executive Officer.

Cooke, A. C. Major R.E.

Assistant.

Petrie, M. Capt. 14th Foot

Ordnance Select Committee.

President.

St. George, J. Col. C.B. R.A.

Vice President.

Wiseman, Sir W. Bart. R.N.

Members.

Robinson, W. Col. R.E.
Greathed, E. H. Col. C.B.

Secretary.

Lefroy, J. H. Col. R.A.

Woolwich.

Superintendent Royal Carriage Department.

Tulloh, Col. Alex. R.A.

Superintendent of Gun Factories.

Armstrong, Sir W. G. C.B.

Enfield.

Superintendent of Small Arm Factories.

Dixon, W. M. H. Lieut.-Col. R.A.

Waltham Abbey.

Askwith, W. H. Col. R.A.

Council of Education.

Vice-President.

Rumley, Randel.

Members.

Portlock, J. E. Maj.-Gen. R.E.
Addison, J. E. Lieut.-Col.
Elwyn, Thos. Col. R.A.

Military Prison.

Inspector-General.

Jebb, Sir Joshua, Maj.-Gen. K.C.B.

Dublin.

Governor.

Rutherford, J. H. Major.

Royal Military College at Sandhurst.

Governor.

Jones, Sir Harry D. Gen. K.C.B. R.E.

Cadets' College.

Superintendent of Studies.

Napier, W. C. E. Col.

PROFESSORS AND MASTERS.

Fortifications.

Adams, W. H. Col.
Griffiths, L. Capt. R.A.
Doull, A. Lieut. R.A.

Military Surveying.

Petley, E. Major.

Military Drawing.

Paterson, Wm. Capt.

Military History.

Chesney, C. C. Capt. R.E.

Staff College.

Commandant.

Macdougall, P. L. Col.

PROFESSORS AND MASTERS.

Military History.

Hamley, E. B. Lieut.-Col. R.A.

Fortifications and Artillery.

Mainwaring, C. E. Capt. R.A.

Military Topography.

Farrell, S. B. Capt. R.E.

Military Administration.

Walker, W. Capt.

East Indian Military College at Addiscombe.

Lieutenant-Governor.

Abbott, Sir F. Major-Gen. C.B.

Staff Officer.

Donnelly, T. Lieut.-Col.

Chelsea Hospital.

Governor.

Blakeney, Rt. Hon. Sir E. Gen. G.C.B. &c.

Lieutenant-Governor.

Woodford, Sir Alex. Gen. G.C.B. &c.

Major.

Wilson, Sir J. M. Col. C.B. K.H.

Physician and Surgeon.

Maclachlan D. M.D. Dep. Ins. Gen.

Adjutant.

Irby, J. J. C. Capt.

Captains of Invalids.

Edwards, Charles, Capt.
Dowman, John, Capt.

Quartermaster.

Farrier, Jas.

Assistant Surgeon.

Howison, Y. Howison, M.D.

Royal Hospital, Kilmainham, Dublin.

Master.

Brown, Sir George, Gen. G.C.B. K.H.

Deputy Master.

Brownrigg, J. S. Col. C.B.

Military Schools.

Assistant Inspector.

Gleig, A. C. Capt. R.A.

Local Inspector.

Lacy, T. E. Col. Gibraltar.

Royal Military Academy at Woolwich.

Governor.

Wilford, E. N. Col. R.A.

Inspector.

Yorke, F. A. Col. R.E.

Assistant Inspector.

Gibb, C. J. Major R.E.

Captain Commandant and Paymaster.

Williams, E. A. Major R.A.

Military Branch.

Fitzhugh, H. T. Major R.A.
Gilmour, C. D. Lieut. R.A.

Professor of Fortification.

Bainbrigge, P. J. Lieut.-Col. R.E.

Professor of Artillery.

Owen, C. H. Major R.A.

Instructors in Fortifications.

Hutchinson, C. S. Capt. R.E.
Wilson, J. J. Capt. R.E.

Instructors in Artillery.

Dames, T. L. Capt. R.A.
Brackenbury, C. B. Capt. R.A.

Instructors in Surveying.

Binney, C. R. Capt. R.E.
Drayson, A. W. Capt. R.A.

Royal Military Asylum, Chelsea.

Commandant.

Crutchley, Chas. Col.

Secretary and Adjutant.

Adams, Edw. Lieut.-Col.

Quartermaster and Paymaster.

Cousins, Wm.

Royal Hibernian School at Dublin.

Commandant.

Mylius, Geo. Col.

Army Medical School at Chatham.

Professor.

Longmore, T. Dep. Ins. Gen.

MILITIA.

ENGLAND AND WALES.

Bedford (Light Infantry).

Colonel.

Gilpin, R. T.

Royal Berks.

Colonel.

Blagrave, John.

Royal Brecknock (Rifles).

Honorary Colonel.

Watkins, Lloyd V.

Lieutenant-Colonel Commandant.

Dickenson, Douglas J.

Captain.

Tupper, A. C.

Cambridge.

Captains.

Bendyshe, John.
Goodwin, Edward.

Royal Cardigan.

Lieutenant-Colonel Commandant.

Powell, W. T. R.

Captain.

Durham, P. F. Adjt.

Royal Carmarthen (Rifles).

Lieutenant-Colonel Commandant.

Dynevor, Lord, Colonel.

Royal Carnarvon and Anglesey (Rifles).

Honorary Colonel.

Pennant, Hon. E. G. D.

Lieutenant-Colonel Commandant.

Williams, T. Peers.

1st Royal Cheshire (Light Infantry).

Adjutant.

White, C. H. Capt.

2nd Royal Cheshire.

Lieutenant.

Wakeman, W. A. J.

Cornwall Rangers (Rifles).

Lieutenant.

Vyvyan, R. H. S.

2nd Derby (Rifles).

Lieutenant-Colonel Commandant.

Cavendish, W. H. F.

Captain.

Arkwright, F.

1st Devon.

Captains.

Hogg, T. D.
Ridgway, Alex.

Dorset.

Lieutenant.

Herd, Chas.

Adjutant and Paymaster.

Smith, E. H.

2nd, or North Durham.

Major.

Cockburn, Alex.

Durham Artillery.

Lieutenant-Colonel.

Hall, Geo.

West Essex.

Captain.

Edenborough, H.

Essex Rifles.

Lieutenant.

Knobel, W. R.

Royal South Gloucester.

Captain.

Le Patourel, Henry.

Royal North Gloucester.

Captain.

Hunte, R. B.

Hampshire.

Colonel.

Winchester, Marquis of.

Majors.

Heathcote, E.
Digweed, W. H.

Captain.

Breton, P. R.

Lieutenant.

Riddell, R. C.

Hampshire Artillery.

Lieutenant-Colonel Commandant.

Burnaby, R. B. Col.

1st Lieutenants.

Campbell, John R.
Staunton, G. S. L.

Assistant Surgeon.

Harrison, W. A.

Hants (Isle of Wight Artillery).

Captain.

Worsley, Francis.

Hereford.

Lieutenant-Colonel Commandant.

Northwick, Lord.

Major.

Symonds, T. P.

Captain.

Cox, R. S.

Hertford.

Captain.

Gaussen, F. C.

Huntingdon.

Major.

Manchester, Duke of.

East Kent.

Lieutenant-Colonel.

Dering, C. E.

Captain.

Pennefather, R. D.

West Kent.

Colonel.

Wilson, Sir T. M. Bart.

Captain.

Weller, T. M. M.

Kent Artillery.

Captain.

Waring, W. T.

1st Royal Lancashire.

Captains.

Feilden, H. M.
Noble, J. G.

2nd Royal Lancashire Rifles.

Major.

Wardlaw, Jas.

Captains.

Johnson, R.
Fitzgerald, P. S.
Rochfort, J. D.
Forde, M.

3rd Royal Lancashire.

Colonel.

Patten, J. W., A.D.C. to the Queen.

Captain.

German, Jas.

4th Royal Lancashire.

Lieutenant-Colonel Commandant.

Blackburne, J. J.

Major.

Phibbs, R.

Captain.

Barlow, Geo.

5th Royal Lancashire.

Major.

Greenwood, Jas.

Lieutenant.

Brockhurst, S. M. S.

6th Royal Lancashire.

Lieutenant-Colonel Commandant.

Pringle, J. H.

Royal Lancashire Artillery.

Lieutenant-Colonel Commandant

Atchison, Thos.

Major.

Middleton, Jas.

Leicester.

Captains.

Mowbray, Geo. Thos.
Chapman, Wm. H.

Royal North Lincoln.

Honorary Colonel.

Tomline, George.

Royal London.

Captains.

Curling, J. B.
Connor, W. H. B.

Royal East Middlesex.

Lieutenant-Colonel Commandant.

Alcock, T. St. Leger.

Captains.

Robertson, W.
Cole, G. C.
Speer, W. D.
Bent, W. H.
Mangles, W. H.

Surgeon.

Dalton, F.

2nd or Edmonton Royal Rifle Regiment.

Honorary Colonel.

Strafford, Earl of.

Captains.

Maycock, D.
Ottley, E. J.
Smith, J.
Read, C. H.
Stephens, F. S. M.
Byass, F.

Lieutenant.

Stephenson, B. C.

Assistant Surgeon.

Godson, Charles.

3rd Royal Westminster Middlesex Light Infantry.

Captains.

Burgess, W. H.
Swan, J. P.

4th or Royal South Middlesex.

Lieutenant-Colonel Commandant.

Scriven, John.

Major.

Kirby, C. F.

Lieutenant.

Jones, W. P. d'Allington.

Royal Elthorne, or 5th Middlesex.

Captains.

Lane, George.
Campbell, R. McDonell.

Royal Monmouth.

Lieutenant-Colonel Commandant.

Vaughan, J. F.

Captain.

Carter, J. M. Adjt.

Ensign.

Allaway, W. A. H. K.

Royal Montgomery and Merioneth Rifles.

Lieutenant-Colonel Commandant.

Morgan, E.

2nd or East Norfolk.

Captain.

Haggard, W. M. R.

Northampton.

Lieutenant-Colonel Commandant.

Burghley, Lord, A.D.C. to the Queen.

Captain.

Hatton, E. F.

Nottingham, or Royal Sherwood Foresters.

Lieutenant-Colonel.

Mellish, W. L.

Northumberland.

Lieutenant-Colonel Commandant.

Bigge, W. M.

Major.

Lovaine, Right Hon. Lord.

Oxford.

Colonel.

Bowles, C. O.

1st Somerset.

Honorary Colonel.

Tynte, C. K. K.

2nd Somerset.

Captain.

Harwood, Edwd.

The King's Own, 2nd Stafford.

Colonel.

Littleton, Hon. E. R.

Captain.

Salt, Thos.

3rd (King's Own) Stafford Rifles.

Honorary Colonel.

Bagot, Charles.

Suffolk Artillery.

Colonel.

Bence, H. B.

Lieutenant-Colonel Commandant.

Adair, R. A. Shafto, Col. A.D.C. to the Queen.

1st Royal Surrey.

Lieutenant-Colonel Commandant.

Evelyn, G. P.

Major.

Scott, G. D.

Captain.

Forbes, Stewart.

Lieutenant.

Godbold, A. B.

3rd Royal Surrey.

Captain.

Flower, Lamorock.

Royal Sussex.

Lieutenant-Colonel.

Lennox, Lord A.

Major.

Gage, Hon. H. E. H.

Surgeon.

Batley, W.

The King's Own Light Infantry.

Lieutenant-Colonel Commandant.

Grant, W. L.

Major.

Parry, F. J.

The Queen's Own Light Infantry.

Colonel.

Wilton, Earl of, G.C.H.

Lieutenant-Colonel.

Walker, Sam.

Major.

Cooper, Henry.

Captains.

Dixon, Wm.
Lawrence, E. E.

1st Warwick.

Captain.

Baxter, S. S.

2nd Warwick.

Lieutenant.

Norris, G. G.

Royal Wiltshire.

Honorary Colonel.

Broughton, Lord, G.C.B.

Lieutenant-Colonel.

Methuen, F. H. P. Lord, A.D.C. to the Queen.

Captain.

Sloper, N. W.

Worcester.

Captain.

Domvile, W.

East York.

Captain.

Grimston, M. J.

North York.

Lieutenant-Colonel Commandant.

Wade, H. C. C.B.

2nd West York.

Colonel.

Smyth, J. G.

Captain.

Brown, H. C. Newton.

4th West York.

Lieutenant-Colonel Commandant.

Massey, Hon. N. H. C.

Captain.

Hare, H. J.

5th West York.

Captains.

Craven, C. D.
Sole, H. W.

Lieutenant.

Williams, L.

6th West York.

Lieutenant-Colonel Commandant.

Hind, Charles. c.

SCOTLAND.

Royal Aberdeenshire Highlanders.

Captains.

Farquhar, A.
Dawes, E. A., Adjutant.

Argyll and Bute.

Lieutenant-Colonel Commandant.

Campbell, John. c.

Royal Ayrshire and Wigton.

Lieutenant-Colonel Commandant.

Ferguson, Sir Jas. Bart.

Dumfries, Roxburgh, and Selkirk.

Majors.

Johnstone, Hon. H. Butler.
Walker, Geo.

Captains.

Lennock, G. J.
Malton, W. D.

Fife Artillery.

2nd Lieutenant.

Waite, J. S.

Royal Perth Rifles.

Honorary Colonel.

Moncrieffe, Sir Thos.

Lieutenant-Colonel Commandant.

Drummond, Hay Henry M.

Ross Rifles.

Honorary Colonel.

Fraser, C. McKenzie.

IRELAND.

Clare.

Lieutenant-Colonel.

Macnamara, F.

North Cork Rifles.

Lieutenant-Colonel.

Stawell, W. St. Ledger Alcock.

Lieutenant.

Leahy, E.

Donegal.

Lieutenant-Colonel Commandant.

Hamilton, Lord Claud.

Major.

Todd, Jas. H.

Donegal Artillery.

Lieutenant-Colonel Commandant.

Fisher, R. Roe.

Royal South Down.

Colonel.

Downshire, Marquis of.

Captain.

Balcombe, Jas. Adjt.

Dublin City Artillery.

Major.

Brettingham, R. W.

Fermanagh.

Colonel.

Enniskillen, Earl of.

King's County.

Colonel.

Rosse, Earl of, K.P.

Leitrim Rifles.

Major.

Forbes, the Hon. W. F.

Limerick County.

Honorary Colonel.

Clare, Right Hon. Earl of.

Limerick City Artillery.

Major-Commandant.

Vereker, Hon. S. P.

Queen's County Rifles.

Lieutenant-Colonel Commandant.

Dunne, F. P. C.

Royal Tyrone Fusiliers.

Major.

Caulfield, J. A.

CHANNEL ISLANDS.

Royal Jersey.

STAFF.

Adjutant-General.

Le Couteur, John, Col. A.D.C. to the Queen.

St. Helier Battalion.

Lieutenant-Colonel Commandant.

Hemery, Clement.

Lieutenant.

De Gruchy, W. L.

Royal Guernsey.

Colonel.

Priaulx, Jas. A.D.C. to the Queen.

YEOMANRY CAVALRY.

Buckinghamshire (Royal Bucks).

Colonel.

Duke of Buckingham and Chandos, K.G.

Major.

Knox, Brownlow.

Captains.

Holmes, T. Knox.
Hibbert, F. D.

Buckinghamshire.

Captain Commandant.

Orkney, Earl of.

Cheshire.

Lieutenant-Colonel.

Egerton, Sir P. de M. Grey.

Captains.

Davenport, A. H.
Hill, Hen. Adjutant.

Denbighshire.

Lieutenant-Colonel.

Tottenham, C. J.

Royal North Devon (Mounted Rifles).

Lieutenant-Colonel Commandant.

Wheler, Sir Trevor, Bart.

Dorset.

Commandant.

Guest, M. J.

Royal Gloucestershire Hussars.

Captain.

Holford, R. S.

Hampshire.

Lieutenant-Colonel Commandant.

Eversley, Viscount, Col. A.D.C. to the Queen.

South Herts.

Captain.

Smith, H. J.

Royal East Kent (Mounted Rifles).

Captain.

Mount Charles, Earl of.

Cornet.

Filmer, Sir E. Bart.

Duke of Lancaster's Own.

Lieutenant-Colonel.

Ellesmere, Earl of.

Lancashire Hussars.

Lieutenant-Colonel.

Gerard, Sir R. T. Bart.

Major.

Gerard, F. S.

Captain.

Anderton, W. J.

Leicestershire.

Lieutenant-Colonel Commandant.

Howe, Earl.

North Salop.

Captains.

Hill, G. S.
Cust, H. F.

North Somerset.

Captain.

Jolliffe, H. H.

West Somerset.

Colonel.

Portman, Hon. W. H. B.

Staffordshire.

Major.

Ackers, G. H.

Westmoreland and Cumberland.

Captain.

Lowther, Henry.

Royal Wiltshire.

Captain.

Goddard, A. L.

Yorkshire Hussars.

Captain.

Lawley, Hon. R. N.

1st West York.

Lieutenant-Colonel Commandant.

Warneliffe, E. M. G. S. Lord.

Captain.

Stanhope, W. T. S.

2nd West York.

Lieutenant.

Clarke, C. Kenny.

The Hon. Artillery Company of London.

Colonel and Captain-General.

Field Marshal H.R.H. The Prince Consort K.G. K.T. K.P. G.C.B. G.C.M.G.

Major.

Robinson, W. T.

Captains.

Biden, J.
Jordan, W. J.
Rough, W. H.
Blockley, J.

Lieutenants.

Lewis, A. J.
Field, J. W. P.
Fox, E.
Goepel, P. D.

Adjutant.

Potts, G. B. Capt.

Quartermaster.

Ballin, Geo.

VOLUNTEER CORPS.

ARTILLERY VOLUNTEERS.

13th Lancashire, 5th Company, Blackburn.

Captain.

Sturdy, J. B. S.

17th Dorsetshire, 2nd Company, Portland.

Captain.

Leather, J. T.

22nd Yorshire (East Riding), 1st Corps, Burlington.

Captain.

Crowe, Robert.

37th Wigton, 1st Company, Stranraer.

Captain.

Dalrymple, Viscount.

48th Yorkshire (West Riding).

Captain Commandant.

Ramsden, Sir J. W. Bart.

Mounted Rifle Volunteers, 1st Huntingdonshire.

Captain Commandant.

Manchester, His Grace the Duke of.

6th Northamptonshire.

Lieutenant.

Loyd-Lindsay, Robt.

RIFLE VOLUNTEERS.

2nd Middlesex, 1st Corps, Victoria, Kilburn.

Lieutenant-Colonel Commandant.

Wellington, His Grace the Duke of, Major-Gen. K.G.

Surgeon.

Croft, C. P. M.D.

11th Corps, St. George's.

Major-Commanding.

Lindsay, Hon. C. H.

12th Barnet, 6th Battalion.

Captain.

Taylor, W.

22nd (Queen's) Westminster.

Captain.

Styan, Arthur.

3rd Lancashire, 6th Corps, 1st Manchester.
Lieutenant-Colonel Commandant.
Grey de Wilton, Viscount.

8th Bury.
Major.
Hutchinson, John.

4th Surrey, 1st Corps (South London).
Captain.
Stephenson, H. J.

6th Esher, 2nd Battalion.
Captain.
Fletcher, Sir Henry, Bart.

9th Richmond, 2nd Battalion.
Captain.
Ommaney, O.

17th Godstone, 3rd Battalion.
Lieutenant.
Sharp, John H.

20th Lower Norwood, 1st Battalion.
Captain.
Ouchterlony, John.

7th Oxford, 1st Corps, University of Oxford.
Honorary Colonel.
His Royal Highness Albert Edward Prince of Wales, K.G. Col.

9th Wiltshire, 9th Corps, Bradford.
Captain.
Pickwick, C. H. S.

10th Sussex.
STAFF.
Lieutenant-Colonel.
Moorsom, R.
Adjutant.
Matthews, F. P.

6th Corps, Petworth, 2nd Battalion.
Captain.
Winterton, Earl of.

17th Norfolk, 1st (City of Norwich).
Lieutenant-Colonel.
Brett, John D.

9th Loddon.
Captain.
Beauchamp, T. W. B. P.

18th Staffordshire.
STAFF.
Lieutenant-Colonels.
Vernon, G. A. (4th Battalion).
Newdigate, F. W. (2nd Battalion).

27th Comp. Patshall, 3rd Battalion.
Captain.
Dartmouth, W. Earl of.

21st Brecknockshire.
STAFF.
Major.
Lindsay, H. G.

1st Corps, Brecon, 1st Battalion.
Captain.
Raikes, Robt.

26th Kent.
STAFF.
Lieutenant-Colonels.
Thorold, G. E. Col.
Hardinge, C. S. Viscount.
Scott, E.

30th Yorkshire (West Riding).
Honorary Colonel.
De Grey and Ripon, Earl.

33rd Aberdeenshire, 1st Corps, Aberdeen.

Captain.

Forbes, Sir W. Bart.

41st Warwickshire.

STAFF.

Lieutenant-Colonel.

Scott, Hon. C. G.

1st Corps (Birmingham).

Captain.

Ratcliff, Chas.

45th Somersetshire.

STAFF.

Lieutenant-Colonel.

Jones, Inigo, W.

49th Shropshire.

STAFF.

Lieutenant-Colonel Commandant.

Hill, Hon. W. N. Col.